Psychedelics and indicators of mental distress in adults: National Survey on Drug Use and Health 2008–2014

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Tiivistelmä

Tavoitteet. Elpyneen kliinisen psykedeelitutkimuksen hoitovasteet psilosybiini- tai LSD-avusteisessa terapiassa näkyvät yhä 12 kk seurannassa. Väestötutkimukset elinaikaisen psykedeelien käytön (edes kerran, Kyllä/Ei) yhteydestä nykyiseen mielenterveyteen raportoivat olemattomia tai suojaavia yhteyksiä huomioituaan sosiodemografian, riskinottotaipumuksen ja muiden aineiden käytön. Tässä selvitettiin, onko psykedeelien käytön äskettäisyys (>12, 1–12 tai <1 kk sitten) yhteydessä viime kuun psykologiseen distressiin, viime vuoden suisidaalisuuteen tai arjen toimintarajoitteisiin. Lisäksi huomioitiin aiemmin esitetty huoli, että aiemmat tulokset johtuisivat muiden aineiden käytön yliadjustoinnista; selvitettiin, kuinka adjustointi tulisi tehdä; ja verrattiin psilosybiinin, LSD:n sekä psilosybiinin ja/tai LSD:n käyttöä keskenään. Kaikki koodi julkaistiin.

Menetelmät. Analyysi perustui aikuisiin vastaajiin vuosien 2008–2014 yhdistetystä National Survey on Drug Use and Health (NSDUH) -aineistosta, joka on Yhdysvaltojen väestöstä satunnaisotannalla kerätty edustava otos. Psykedeeliä ja sen käytön äskettäisyyttä edustavat vertailuryhmät pääteltiin aineistosta. Painotetut vedonlyöntikertoimet laskettiin huomioiden sosiodemografia, riskinottotaipumus ja muiden aineiden käyttö, joka verrattain adjustoitiin käytön elinaikaisuuden tai äskettäisyyden mukaan. Heroiinin ja crack-kokaiinin äskettäisyys peilaten adjustoitiin tutkittaessa, yhdistyvätkö ne psykologiseen distressiin odottamattomasti suojaavasti, mikä viestisi yliadjustoinnista myös psykedeeliyhteyksien kohdalla.

Tulokset. Kohonnutta riskiä viime kuun psykologiseen distressiin, viime vuoden suisidaalisuuteen tai arjen toimintarajoitteisiin ei esiintynyt millään psykedeeliryhmällä millään käytön äskettäisyydellä. Madaltunut riski viime vuoden itsemurha-ajatuksille esiintyi ryhmillä, jotka olivat käyttäneet psykedeelejä yli 12 kk sitten tai psilosybiiniä alle 1 kk sitten, sekä viime vuoden itsemurhasuunnitelmille ja viime kuun vakavalle psykologiselle distressille niillä, joiden viimeaikaisin käyttö oli psilosybiini yli 12 kk sitten. Viimeaikaisempi crack-kokaiinin tai heroiinin käyttö oli yhteydessä viime kuun psykologisen distressin kohonneeseen riskiin myös huomioitaessa muiden aineiden elinaikainen käyttö. LSD:n ja psilosybiinin vertailu ei onnistunut johtuen yllättävän pienistä LSD-ryhmistä. Muiden aineiden käytön adjustoinnilla oli iso merkitys, mutta adjustoinnit käytön elinaikaisuudella tai äskettäisyydellä eivät eronneet keskenään.

Johtopäätökset. Tutkimus vahvasti tukee aiempien väestötutkimusten tuloksia, sillä psykedeelien käytölle itsenäistä riskiä ei esiintynyt edes huomioitaessa käytön äskettäisyys. Tulokset yhtenevät myös aiempiin tutkimuksiin, joiden mukaan psykedeelit eivät aiheuta riippuvuutta ja saattavat pitkäaikaisesti parantaa ahdistusta, masennusta, neuroottisuutta, riippuvuutta, kognitiivista muovautuvuutta ja merkityksellisyyttä.

Avainsanat

psykedeelit, psilosybiini, LSD, psykologinen distressi, suisidaalisuus, arjen toimintarajoitteet, NSDUH

Säilytyspaikka

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Abstract

Objectives. Renewed clinical research finds treatment effects from psychedelic (psilocybin or LSD)-assisted therapy sustained at 12 month follow-up. Population studies find the association between lifetime psychedelic use (even once, Yes/No) and current mental health absent or protective after adjusting for sociodemographics, risk-taking tendency, and non-medical use of other drugs. This study aimed to investigate whether the recency of psychedelic use (>12, 1–12, or <1 months ago) is associated with past month psychological distress, past year suicidality, or everyday impairment. This study also addressed a previously expressed concern that the previous results stem from overadjustment for non-medical use of other drugs, explored how such adjustments should be done, and compared use of psilocybin, LSD, and psilocybin and/or LSD. All code was published.

Methods. The analysis was based on combined data of adult respondents of the National Survey on Drug Use and Health (NSDUH) years 2008–2014 randomly selected to be representative of the population of the United States. Comparison groups by the psychedelic used and its recency of use were inferred from the data. Weighted odds ratios were calculated adjusting for sociodemographics, risk-taking tendency, and non-medical use of other drugs. Adjustments for other drug use were compared between a minimally adjusted model, a lifetime use-adjusting model, and a recency of use-adjusting model. Mirroring adjustments were made in order to see whether crack cocaine and heroin use recency would associate to psychological distress in an unexpectedly protective way, indicating overadjustment in the psychedelic recency associations.

Results. No independent association between any recency of any psychedelic use and increased likelihood of past month psychological distress, past year suicidality, or everyday impairment was found. A decreased likelihood for past year suicidal thinking was found among all groups that had last used psychedelics >12 months ago or psilocybin <1 month ago, as well as for past year suicide plans and past month serious psychological distress among those whose last psychedelic use was psilocybin >12 months ago. More recent crack cocaine or heroin use was still associated with a higher risk for past month serious psychological distress after adjusting for lifetime non-medical use of other drugs. LSD and psilocybin could not be properly intercompared due to surprisingly small LSD-only recency groups. Adjusting for non-medical use of other drugs made a big difference, but adjustments for their lifetime use or recency of use did not mutually differ.

Conclusions. This study strongly supports the results of previous population studies, as no independent risk from psychedelic use was found even when considering their recency of use. The results are also consistent with research indicating that psychedelics may have long-lasting beneficial effects for anxiety, depression, neuroticism, substance dependence, cognitive flexibility, and meaningfulness, and do not lead to dependence.

Keywords
psychedelics, psilocybin, LSD, psychological distress, suicidality, everyday impairment, NSDUH

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Contents

1. Introduction

Psychedelic drugs such as lysergic acid diethylamide (LSD) were subject to widespread scientific and clinical interest in the 1950s and 1960s.[†] Nevertheless, clinical research on psychedelics effectively ended for over 30 years after the Controlled Substances Act of 1970 when LSD and other psychedelics known at the time were placed into the most restrictive category of drugs (Schedule 1).[2] This classification was not based on scientific evaluation of psychedelics or their clinical potential, but rather followed from the wider role psychedelics had come to play in the antiwar or anti-authoritarian counterculture in the United States of the 1960s and 1970s.[1,2] Public perception of the effects of psychedelics might be distorted to this day by the sensationalized reports of recreational psychedelic use that originate from this politically charged era.[2]

Historically, serotonergic psychedelics such as psilocybin (found in more than 200 species of mushrooms), mescaline (found in the peyote cactus), and *N*-*N*-dimethyltryptamine (DMT) (orally active as part of a traditional brew called ayahuasca) have been known and used by humans for at least several millennia.[2] Together with LSD (derived from the ergot fungus but discovered in 1943), these compounds constitute the extensively researched pharmacological group of classic psychedelics.[2] Physiologically, these classic psychedelics are among the safest and least toxic substances known to affect the central nervous system.[2] Serotonergic psychedelics do not have direct effects on brain dopaminergic systems and do not lead to dependence or addiction.[2]

In the 2010s, there has been a resurgence of research on human treatment with classic psychedelics. Promising results have been shown with psilocybin in treating alcohol

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[†] Grinspoon and Bakalar describe the scope of this in their book, *Psychedelic Drugs Reconsidered* (1997): "Many people remember vaguely that LSD and other psychedelic drugs were once used experimentally in psychiatry, but few realize how much and how long they were used. This was not a quickly rejected and forgotten fad. Between 1950 and the mid-1960s there were more than a thousand clinical papers discussing 40,000 patients, several dozen books, and six international conferences on psychedelic drug therapy. It aroused the interest of many psychiatrists who were in no sense cultural rebels or especially radical in their attitudes."[1]

dependence,[3] tobacco dependence,[4,5] treatment-resistant depression,[6–8], life-threatening disease-associated anxiety[9] as well as anxiety and depression,[10,11] and with LSD in treating life-threatening disease-associated anxiety.[12,13] Most of these indications for psychedelic-assisted therapy are not a recent invention, although the recent studies are more methodologically rigorous.[14] The modern treatment programs consist of only a few psychedelic-assisted sessions in a supportive setting combined with preparatory and integrative psychotherapeutic or other psychosocial support some weeks apart.[3,4,6,9–12] Adverse effects in all of these studies are predominantly mild and transient.[3–13]

Naturally, only a negligible minority of present-day human psychedelic use occurs within such supportive research settings. A population study from 2010 estimated that over 30 million people in the United States alone have used classic psychedelics (including 17% of people aged 21–64, and 20% of people aged 30–34), most commonly LSD (23 million) and psilocybin (21 million).[15] Despite their safety in the physiological sense as well as the relative absence of adverse effects in controlled research settings, classic psychedelics can cause temporary but profound alterations in cognition and mood that can lead to unpredictable behavior and symptoms of psychological distress especially in unsupervised or uncontrolled conditions such as might be common among recreational users.[2] To help reevaluate present-day classic psychedelic use, this study draws data from a large sample continuing recent population studies on the association between classic psychedelic use and indicators of mental distress, focusing specifically on the recency of non-medical LSD and psilocybin use in the United States adult population between years 2008 and 2014.

1.1. Background

1.1.1. Psychedelic use and mental health in the general population

Krebs and Johansen (2013) combined data from National Survey on Drug Use and Health (NSDUH) years 2001–2004 to study the role of lifetime use of classic psychedelics (even once) as a potential risk factor for current mental health problems.[16] Included as classic psychedelics were psilocybin, LSD, mescaline, and peyote.[16] Mental health indicators were serious psychological distress (K6 scale), mental health treatment (inpatient, outpatient, medication, needed but did not receive), symptoms of eight psychiatric disorders (panic disorder, major

depressive episode, mania, social phobia, general anxiety disorder, agoraphobia, posttraumatic stress disorder, and non-affective psychosis), and seven specific symptoms of non-affective psychosis.[16] Weighted odds ratios were calculated by multivariate logistic regression adjusting for sociodemographic variables (current age, gender, race/ethnicity, education, household income, marital status), lifetime non-medical use of other drugs, risk-taking tendency, and exposure to traumatic events.[16] No associations were found between psychedelic use and mental health indicators, suggesting that lifetime use of psychedelics is not an independent risk factor for mental health problems.[16]

In a similar study, Johansen and Krebs (2015) combined NSDUH years 2008–2011 adjusting for the same covariates as previously[16] with the two differences that for these years, childhood depressive episode could be included whereas lifetime exposure to an extremely stressful event was unavailable.[17] Available past year mental health indicators shared with the previous study were serious psychological distress during the worst month of the past year (K6 scale) and mental health treatment, including treatment for substance disorders (inpatient, outpatient, psychiatric medication prescription, felt a need for but did not receive mental health treatment).[17] Additionally, new mental health indicators (unavailable in the previous study) were suicidal thoughts, suicidal plans, and suicide attempt (all during the past year), and symptoms of major depressive episode (assessed with a different questionnaire), physician diagnosis of depression, and physician diagnosis of an anxiety disorder.[17] No associations were found between lifetime use of classic psychedelics (psilocybin, LSD, mescaline, or peyote) and increased likelihood of past year serious psychological distress, mental health treatment, suicidal thoughts, suicidal plans, suicide attempt, depression, nor anxiety.[17]

Focusing specifically on past month psychological distress and past year suicidality as mental health indicators, Hendricks et al. (2015) combined NSDUH years 2008–2014 to study lifetime use of classic psychedelics, including the ones counted in previous studies[16,17] as well as DMT and ayahuasca.[18] Adjustment variables included (similar to the previous studies[16,17]) sociodemographic variables, lifetime non-medical use of other drugs, and self-reported risk-taking tendency.[18] Lifetime classic psychedelic use was associated with a decreased odds of past month psychological distress, past year suicidal thinking, past year suicidal planning, and past

year suicide attempt, whereas lifetime non-medical use of other drugs was largely associated with an increased likelihood of these indicators.[18]

In an extension analysis, Hendricks, Johnson, and Griffiths (2015) focused specifically on the association of lifetime psilocybin use and the odds of past month psychological distress and past year suicidality (thoughts, plans, attempt) due to the growing possibility that approved medical use will be sought for psilocybin in the near future.[19] Methods and analysis were similar to those of the other study except that this time multiple planned contrasts were conducted to arrive at the associations between the mental health indicators and lifetime psilocybin use per se.[18,19] The results show that out of all the classic psychedelics, psilocybin may be especially protective in relation to psychological distress and suicidality.[19] Addressing a safety concern, the results are not supportive of the idea (based on the sensationalized cultural history of psychedelics) that psilocybin itself would increase the risk of suicide, indicating rather decreased suicidality.[19]

Depending on the causal pathways between lifetime use of psychedelics and other drugs, the practice of adjusting for non-medical use of other drugs might be a risk for what has been called overadjustment bias.[20] This concern of adjustments in the previous NSDUH-based population studies is raised by Nesvåg, Bramness, and Ystrom,[21] to which Krebs and Johansen reply that people who have used psychedelics but no other illicit substances are not representative of the total population of people who have used psychedelics.[21] Hendricks, Johnson, and Griffiths add that the risk of overadjustment bias in this case is present only insofar as "other lifetime illicit substance use [is] a *consequence* of lifetime classic [psychedelic] use" and that failure to adjust for these covariates would represent a failure to account for suicide risk factors in order to learn about the independent role of lifetime psychedelic use.[19] Nevertheless, the present study will include an attempt to address this concern of overadjustment bias resulting from the adjustment of non-medical use of a range of nonpsychedelic drugs.

1.1.2. Sustained effects in clinical studies

Possibly long-lasting changes in personality characteristics following psychedelic sessions were documented already in the 1960s.[22] Modern research assessing the effects of psilocybin on the personality traits of Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness—thought to be "predominantly stable after age 30" as well as experimentally

unchangeable—found that high-dose (30 mg/70 kg) psilocybin sessions were followed by increases in Openness from screening to post-test.[23] For those 30 participants whose first session was an inactive placebo, methylphenidate, or a lower dose (5 mg/70 kg) of psilocybin, there were no changes in Openness post-session.[23] No changes were observed for the other four personality factors.[23] The persistence of these effects was assessed at the long-term follow-up more than 1 year (M = 16 months) after the high-dose session.[23] The long-term follow-up assessment indicated that Openness was nearly identical at screening and at long-term follow-up for those participants who had not had a complete mystical experience during their psilocybin sessions (n=21), whereas for those who had had a complete mystical experience (n=30), Openness at long-term follow-up did not differ from Openness at post-test and remained higher than at screening.[23]

Another study explored possible changes in personality structure after psilocybin (10 and 25 mg, one week apart) with psychological support was given to 20 patients suffering from treatment-resistant depression.[24] Compared to baseline, multiple traits were different at 3 months after the psilocybin treatment: Neuroticism had decreased, Extraversion increased, and Openness increased.[24] Agreeableness had not changed, whereas Conscientiousness had increased.[24]

An open-label pilot study of 2–3 psilocybin sessions as adjuncts for smoking cessation assessed not only treatment success but also the personal meaningfulness and spiritual significance that participants attributed to the psilocybin experiences in the study sessions.[4] Of the 15 participants, 13 (87%) named at least one psilocybin session among the ten most meaningful experiences of their lives, 11 (73%) named at least one psilocybin session among the five most spiritually significant experiences of their lives, and 13 (87%) said that their personal well-being or life satisfaction had increased very much as a result of at least one psilocybin session.[4] In long-term follow-up assessment 1 year later, the rankings seemed to have remained strong if not strengthened, as 13 (87%) named these psilocybin experiences among the five most meaningful experiences of their lives, and similarly 13 named these psilocybin experiences among the five most spiritually significant experiences of their lives.[5]

1.2. The present study

The present study aims to continue the previously published population studies on the association between psychedelic use and mental health. A large sample will be obtained by combining multiple years of NSDUH data. Indicators of mental health as well as choice of cutoff points and adjustment variables will be comparable to those in the previous studies. A specific difference to previous studies will be to focus on the recency (>12, 1–12, or <1 months ago) of psychedelic use instead of lifetime use (even once, Yes/No) of psychedelics. Due to renewed clinical interest in research concerning psilocybin and LSD, the present study will also focus on comparing these two substances. Additionally, to examine the effects of adjusting for non-medical use of other drugs and of how it is done, a minimally adjusted model will be employed for comparison throughout the study, and the models that adjust for the lifetime non-medical use of other drugs will be accompanied by models adjusting instead for the recency of their non-medical use. Finally, an effort to account for a possible overadjustment bias will be made by examining crack cocaine and heroin use recencies as predictors instead of psychedelic use recencies and by considering how the resulting associations depend on the set of adjustments used.

2. Methods

2.1. Research questions and hypotheses

Similar to the previous population studies on psychedelics and mental health, the present study aims to answer the following empirical questions:

1. Is psychedelic use associated with psychological distress after adjusting for sociodemographics, risk-taking tendency, and non-medical use of other drugs?
2. Is psychedelic use associated with suicidality after adjusting for sociodemographics, risk-taking tendency, and non-medical use of other drugs?

Novel additions in the present study will be to answer the questions:

3. Is psychedelic use associated with everyday impairment after adjusting for sociodemographics, risk-taking tendency, and non-medical use of other drugs?
4. Is the recency of psychedelic use independently associated with any of these indicators?

5. Is there a difference in any of the associations between psychedelic use recency and the chosen outcomes depending on which psychedelic was used (psilocybin and/or LSD, psilocybin only, or LSD only)?
6. Does it make a difference for the associations if non-medical use of other drugs is adjusted for by considering their lifetime use (even once, Yes/No) versus the recency of their last use (versus not at all)?

Informed by previously published research, the following hypotheses are warranted (after adjusting for sociodemographics, risk-taking tendency, and [for hypotheses A–C] non-medical use of other drugs):

A. Recency of psychedelic use is not associated with a higher likelihood for psychological distress.
B. More recent psychedelic use is associated with a lower likelihood for suicidality.
C. Recency of psychedelic use is not associated with a higher likelihood for everyday impairment.
D. The results are different before and after adjusting for non-medical use of other drugs.

2.2. Data and weighting

Like previous population studies on psychedelics and mental health, this study is based on data from the National Survey on Drug Use and Health (NSDUH).[25] The NSDUH is a nationwide study conducted in the United States where annually approximately 70,000 participants are selected at random to be representative of the general civilian population aged 12 and older.[25] Those who volunteer to participate are interviewed personally in their own homes for about an hour and receive $30 in cash for completing the full interview.[25] Participants answer most of the questions privately and directly on a laptop so that even the interviewer does not know the answers.[25] All information collected by the NSDUH is confidential and to be used only for statistical purposes as required by federal law.[25]

The data set used for this study was the 2002–2015 NSDUH public use data file with an initial total of 779,799 records.[26] The data set was filtered for only the years that included the mental health indicators and adjustment variables to be used, resulting in a subset consisting of the seven years of 2008–2014. Consequently, all the figures and tables in this study were calculated

accounting for the NSDUH weighting variable indicating that seven years of combined data were used (ANALWC7) unless otherwise noted.[26]

2.3. Psychedelic recency groups

Psychedelic recency groups to indicate the amount of time since one had last used a specific psychedelic were not initially contained in the NSDUH data set except for some of the substances. Thus, the psychedelic recency groups were inferred from the available variables by first excluding observations with imprecise values for the time since they had last used any NSDUH-defined hallucinogen (LSD, psilocybin, mescaline, peyote, ecstasy, PCP, or an unlisted hallucinogen). Three groups were then created by following an exclusion logic detailed in the code appendix (Appendix D) to arrive at indicators for whether one had last used psychedelics over 12 months ago, between 1 and 12 months ago, or less than 1 month ago, and whether the psychedelic had been psilocybin and/or LSD, psilocybin only, or LSD only (with no other NSDUH-defined hallucinogen having been used during the indicated time period).

To establish comparability between the specific psychedelic used, the psilocybin-only group was made to consist only of those who had never used LSD and the LSD-only group only of those who had never used psilocybin. All groups also excluded those who had ever used mescaline, peyote, or an unlisted hallucinogen. Ecstasy or PCP use was allowed but only if it was less recent than the psychedelic recency; in other words, those whose last psychedelic use was less than 1 month ago or 1–12 months ago were allowed to have used ecstasy or PCP over 1 month ago or over 12 months ago, respectively. This decision was made in order to maintain larger sample sizes in the smaller psychedelic recency groups and because ecstasy and PCP are, for the purposes of this study, not comparable to psilocybin and LSD in the same ways that mescaline, peoyte, and other classic psychedelics are.

2.4. Indicators of mental distress

2.4.1. Psychological distress

As an indicator of psychological distress, the Kessler Psychological Distress (K6) scale was used. The K6 is a measure of general, non-specific psychological distress.[27] The measure is calibrated to predict any mental disorder found in the *Diagnostic and Statistical Manual of*

Mental Disorders (DSM-IV)[28] except problems relating to drug use.[27] The measure has only six items and is thus easy to use, but it has also shown a sensitivity of .36 (*SD* = .08) and specificity of .96 (*SD* = .02) in predicting mental disorders.[27] The reliability (Cronbach's alpha) of K6 was found to be .94.[27] In the present study, the same generally recommended cutoff point of K6 ≥ 13 was used for indicating serious psychological distress as was used by Krebs and Johansen in their studies.[16,17] In addition, a cutoff point of K6 ≥ 5 was used as the optimal lower threshold to indicate moderate mental distress based on previous research.[29]

The score for past month psychological distress (ranging between 0–24) is a sum of answers to six questions. Each of the questions asks how often the respondent felt a specific symptom of psychological distress during the past month (with "all of the time" coded as 4; "most of the time", 3; "some of the time", 2; and "a little of the time", 1). The questions include: feeling nervous, feeling hopeless, feeling restless or fidgety, feeling so sad or depressed that nothing could cheer you up, feeling that everything was an effort, and feeling down on yourself, no good, or worthless. Unweighted pre-adjustment proportions within each psychedelic recency group for serious and moderate past month psychological distress can be found in Appendix B.

2.4.2. Everyday impairment

As an indicator of serious everyday impairment, the WHO Disability Assessment Schedule (WHODAS) was used; specifically, the eight-item alternative total score of the NSDUH (WHODASC3) was chosen for comparability with the K6.[30] The eight-item WHODAS score ranges between 0–8 after a value of 1 is assigned to each of the daily activities that a respondent indicated having "moderate" or "severe" difficulty performing, or if the respondent indicated not performing the activity due to problems with emotions, nerves, or mental health, during the emotionally worst month of the past year. The activities are: remembering to do things they needed to do, concentrating on doing something important when other things were going on around them, going out of the house and getting around on their own, dealing with people they did not know well, participating in social activities, taking care of household responsibilities, taking care of daily responsibilities at work or school, and getting daily work done as quickly as needed.[30] As a cutoff point that would indicate everyday impairment of severity comparable to serious psychological distress (defined as K6 ≥ 13), the point of WHODASC ≥ 3 was chosen

based on a cutoff point calibration study.[31] Unweighted pre-adjustment proportions within each psychedelic recency group for serious everyday impairment can be found in Appendix B.

2.4.3. Suicidality

Three indicators for suicidality were past year serious suicidal thoughts ("Did you seriously think about killing yourself?"), past year suicide plans ("Did you make any plans to kill yourself?"), and past year (unsuccessful) suicide attempt ("Did you try to kill yourself"?). The variables for past year suicide plans and attempt were both recoded as 'No' for those who had answered past year serious suicidal thoughts with 'No'. Unweighted pre-adjustment proportions within each psychedelic recency group for these indicators can be found in Appendix B.

According to a study of adult suicidality based on NSDUH data sets from 2008–2012, the prevalence of past year suicide attempt among those with past year suicidal thoughts is 13.2% and is more common among those with a suicide plan (37.0%) versus those without a plan (3.7%).[32] In many cases, past year suicide attempt is more likely among those with past year suicidal thoughts if they are female, belong to a racial/ethnic minority, or have lower education.[32] Suicidality is also related to alcohol use and use disorder.[32] Suffering from major depression is associated with an increased likelihood for having suicidal thoughts, although the results of the study "confirm a previous finding that major depression, per se, may not trigger further progression from ideation to plan and attempt or from ideation to attempt".[32] Similarly, unemployment increases suicidal thinking among the 18–25 year old age group while being married decreases it among those aged 26 or older, but neither employment nor marital status is related to past year suicide attempt within those who already report past year suicidal thinking.[32]

2.5. Adjustments

2.5.1. Sociodemographics and risk-taking tendency

Those who reported having used psychedelics tended to differ along a range of sociodemographic variables as well as self-reported risk-taking tendency (Table 1). The variables were chosen in order to keep the analyses comparable with previous research.[16–18] Respondents less than 18 years old were excluded from the sample before calculating the within-group proportions.

Compared to those who reported never having used psychedelics, those who did report any recency of psychedelic use (>12, 1–12, or <1 months ago) tended to more often be white, male, and like to test themselves doing risky things. There were also age differences between the groups. Notably, over 66% (weighted) of those who reported psychedelic use within the past year were less than 25 years old, while only 14.4% (weighted) of those who reported never having used psychedelics fell into this age category. Out of all the psychedelic recency groups, only those whose most recent psychedelic use was LSD over 12 months ago had a higher proportion of respondents aged 35 or older (82.5% weighted) compared to those who reported never having used psychedelics (71.1% weighted).

There were also differences in education. Compared to those who reported never having used psychedelics, there were more college graduates among those whose last psychedelic use was psilocybin over 12 months ago. Moreover, all of the groups who reported having taken psychedelics most recently 1–12 months ago tended to have a higher proportion of respondents with some college education. A much higher proportion of those who had used LSD less than one month ago reported having less than high school education (40.6% weighted) compared to those who had never used psychedelics (14.9% weighted) or to those who had used psilocybin, or psilocybin and/or LSD, less than one month ago (14.3% and 15.6% weighted, respectively).

With regard to marital status and income, those whose most recent psychedelic use was within the past year tended to be less often married compared to those who had never used psychedelics. They also reported annual household income of less than $20,000 at a higher proportion. Naturally, many of these other differences are largely related to the noted age differences between those who reported having used psychedelics and those who did not.

Table 1. Weighted within-group distributions for sociodemographics and risk-taking tendency.

	Psychedelic group									
	Never used	Psilocybin and/or LSD			Psilocybin			LSD		
Recency (months)		>12	1–12	<1	>12	1–12	<1	>12	1–12	<1
Unweighted *N*	220925	11846	1888	462	4556	980	213	4006	182	39
	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
Age at interview										
18–20	5.9	1.5	27.5	36.5	3.3	32.3	37.3	0.6	50.7	37.5
21–25	8.5	6.3	39.8	35.9	14.2	42.9	37.0	2.3	41.1	28.7
26–34	14.5	18.2	22.7	14.7	22.7	20.3	16.5	14.6	8.3	4.5
35+	71.1	74.1	10.0	12.9	59.8	4.6	9.2	82.5	0.0	29.3
Education										
Less than high school	14.9	9.9	12.6	15.6	6.8	13.0	14.3	12.0	8.9	40.6
High school graduate	30.5	27.0	27.6	29.3	18.5	28.3	31.7	33.2	29.4	28.1
Some college	25.3	29.5	35.2	34.8	30.3	36.0	30.1	28.6	48.1	20.5
College graduate	29.2	33.6	24.6	20.3	44.3	22.7	23.9	26.2	13.6	10.8
Gender										
Male	45.8	59.0	69.3	64.5	60.1	69.0	65.9	53.7	60.1	49.6
Female	54.2	41.0	30.7	35.5	39.9	31.0	34.1	46.3	39.9	50.4
Race/ethnicity										
Non-Hispanic White	64.8	86.1	83.8	80.7	86.9	81.0	78.3	82.6	80.7	86.3
Non-Hispanic Black/ African American	12.6	3.1	2.6	4.7	1.3	2.6	3.2	5.8	6.2	1.9
Non-Hispanic Native American/Alaska Native	0.4	0.6	0.4	0.4	0.6	0.7	0.3	0.6	0.0	0.0
Non-Hispanic Native Hawaiian/Pacific Islander	0.4	0.2	0.1	0.2	0.1	0.1	0.0	0.3	0.0	1.8
Non-Hispanic Asian	5.3	1.1	1.8	0.3	1.8	1.4	0.3	0.9	3.0	0.0
Non-Hispanic more than one race	1.2	1.8	1.5	2.5	2.0	2.0	5.0	1.7	1.4	0.0
Hispanic	15.4	7.1	9.8	11.3	7.3	12.2	12.8	8.1	8.7	10.0
Marital status										
Married	54.7	55.3	10.7	7.5	52.1	7.1	9.2	57.3	4.9	21.8
Widowed	6.8	1.8	0.2	0.8	1.2	0.0	0.0	2.5	0.0	7.5
Divorced or separated	13.2	19.3	6.1	6.3	13.7	3.8	7.0	23.1	1.2	1.8
Never been married	25.2	23.7	83.0	85.3	33.0	89.1	83.8	17.2	93.9	68.9
Annual household income										
Less than $20,000	18.4	13.4	29.4	39.7	12.7	31.4	39.2	14.5	36.1	39.0
$20,000–$49,999	32.8	28.3	32.3	31.6	25.7	31.7	30.8	30.9	23.7	45.1
$50,000–$74,999	17.1	18.2	11.7	10.2	16.7	12.4	8.1	18.9	15.7	4.0
$75,000 or more	31.7	40.0	26.6	18.4	45.0	24.4	21.9	35.8	24.4	11.9
Likes to test self by doing risky things										
Never	56.5	30.8	12.4	13.2	24.2	13.2	9.7	38.1	15.4	15.3
Seldom	32.0	46.8	44.3	41.1	49.4	43.8	38.1	44.8	35.9	58.3
Sometimes	10.5	20.8	36.6	38.7	24.4	36.9	43.2	16.1	40.4	22.1
Always	1.0	1.6	6.7	6.9	2.1	6.1	9.0	1.1	8.2	4.3

Note: wt%: weighted proportion of group.

2.5.2. Non-medical use of other drugs

There were large initial differences in the use of nonpsychedelic drugs between those who reported any recency (>12, 1–12, or <1 months ago) of psychedelic use and those who did not. Within-group proportions of lifetime non-medical use (even once, Yes/No) of various substances are shown separately for the groups whose last psychedelic use was over 12 months ago (Figure 1), between 1 and 12 months ago (Figure 2), and less than one month ago (Figure 3). A combined table of all the within-group proportions can be found in Appendix A.

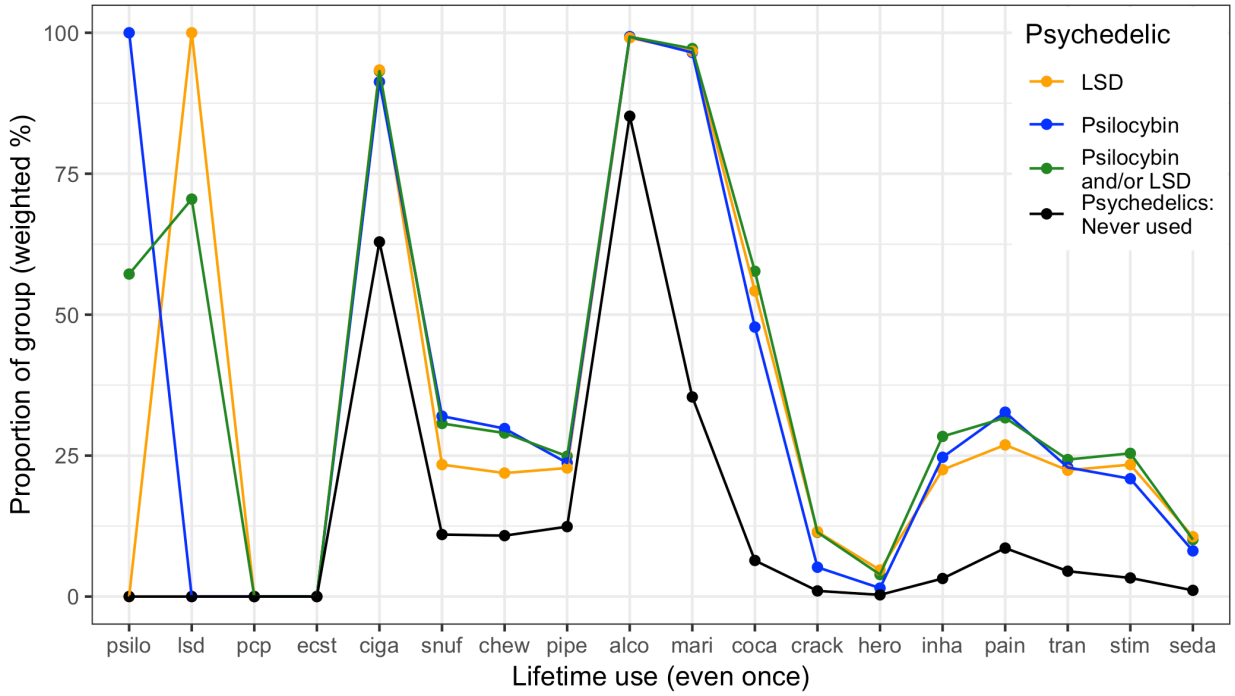

Figure 1. Lifetime non-medical use of other substances within groups whose most recent psychedelic use was over 12 months ago. Left to right: psilocybin, LSD, phencyclidine, ecstasy, cigarettes, snuff tobacco, chew tobacco, pipe tobacco, alcohol, marijuana, cocaine, crack cocaine, heroin, inhalants, pain relievers, tranquilizers, stimulants, and sedatives. For a side-by-side comparison of all recency groups, see Appendix A.

A clear general trend is that the proportion of respondents who report having ever used other substances is higher for every substance among those who report having used psychedelics compared to those who report having never used psychedelics. The lack of respondents with ecstasy or phencyclidine (PCP) use in the recency category of over 12 months (Figure 1) is due to the decision to exclude these people (as explained in section 2.3.). Some history of ecstasy use

was common in the other recency groups even though it was allowed only on the condition that it was less recent than the psychedelic recency. Ecstasy use was later included in the models as an adjustment variable in order to account for these differences between the psychedelic recency groups.

Lifetime use of marijuana (cannabis) was on par with alcohol (close to 100%) among the psychedelic recency groups, whereas of those who reported having never used psychedelics, only 35.4% (weighted) reported lifetime marijuana use. Past year frequencies (number of days, ranging from 0–365) of alcohol and marijuana use were included as adjustment variables in both

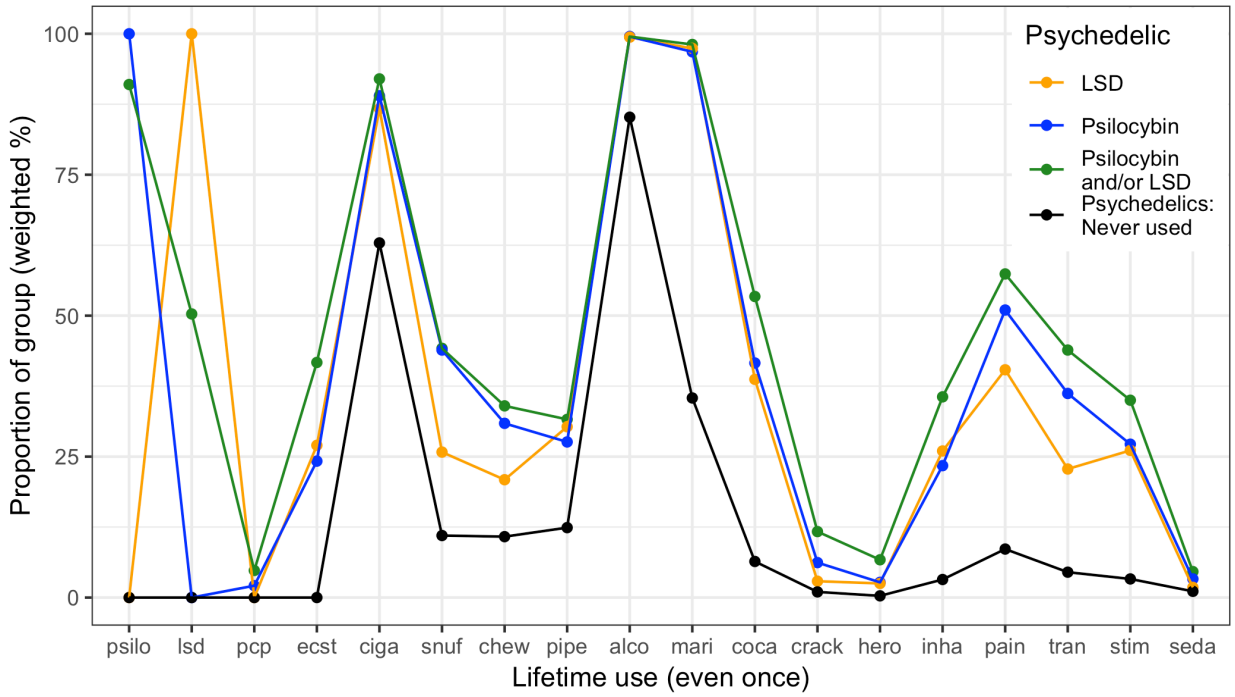

Figure 2. Lifetime non-medical use of other substances within groups whose most recent psychedelic use was 1–12 months ago. Left to right: psilocybin, LSD, phencyclidine, ecstasy, cigarettes, snuff tobacco, chew tobacco, pipe tobacco, alcohol, marijuana, cocaine, crack cocaine, heroin, inhalants, pain relievers, tranquilizers, stimulants, and sedatives. For a side-by-side comparison of all recency groups, see Appendix A.

of the models that adjusted for non-medical use of nonpsychedelic drugs. Use of various tobacco products was not included in the adjustment variables.

One problem with adjusting only for the lifetime use (even once, Yes/No) of other substances is that it does not account for the difference between having used something once (for example,

years or decades ago when one was young) or having used it during the past month or year where it might have had a more substantial role with regards to the mental health indicators concerning the same more recent time period. Therefore, in addition to the model adjusting for lifetime non-medical use of nonpsychedelic drugs (similar to previous research), another model was employed that adjusted for the recency of use for each of the same substances. The recency levels for these adjustment variables were the same as those in the psychedelic recency groups (i.e., whether the respondent had most recently non-medically used the substance 'Never', or >12 months ago, 1–12 months ago, or <1 month ago).

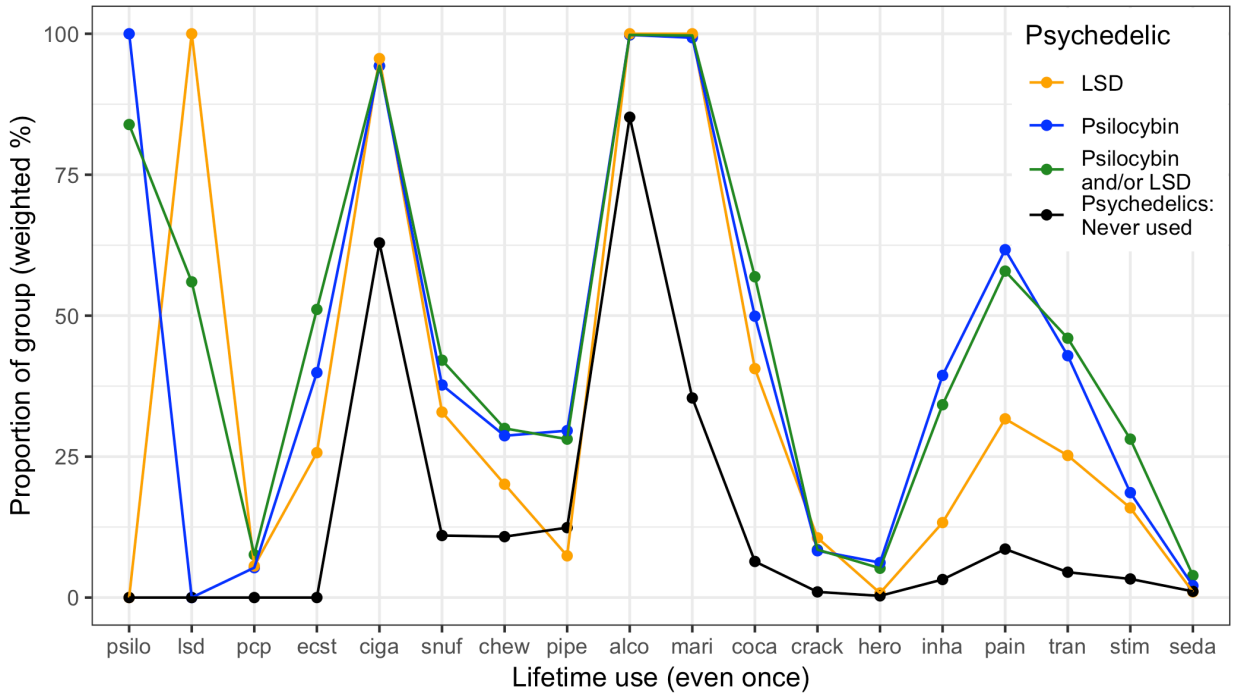

Figure 3. Lifetime non-medical use of other substances within groups whose most recent psychedelic use was less than one month ago. Left to right: psilocybin, LSD, phencyclidine, ecstasy, cigarettes, snuff tobacco, chew tobacco, pipe tobacco, alcohol, marijuana, cocaine, crack cocaine, heroin, inhalants, pain relievers, tranquilizers, stimulants, and sedatives. For a side-by-side comparison of all recency groups, see Appendix A.

2.6. Statistical analysis

All statistical analyses were done in R language (version 3.4.1)[33] and using RStudio (version 1.0.153)[34]. Additionally installed packages were tidyverse (version 1.2.1)[35], varhandle (version 2.0.3)[36], and survey (version 3.34)[37,38]. All the R code for this study can be found in Appendix D.

The main statistical analysis for this study was binomial regression to calculate weighted and adjusted odds ratios for the associations between psychedelic recency group membership and dichotomous indicators of mental distress. Adjustments for the models included sociodemographics variables, risk-taking tendency, and non-medical use of other drugs. All main results across all sets of adjustments are combined in the table in Appendix C.

2.7. Accounting for overadjustment bias

When adjusting for multiple intercorrelated variables of drug use, there is a risk of overadjustment bias.[20] In order to test for the possible presence of such a bias in these analyses, a similar model will be employed with the difference that instead of using psychedelic recency groups as predictors, it will look at the associations of crack cocaine and heroin use recency and past month serious psychological distress, as previous research does not give us reason to believe that crack cocaine or heroin use would be associated with a lower likelihood of past month serious psychological distress, being evaluated as the most harmful drugs to individuals (in the United Kingdom in 2010).[39]

3. Results

3.1. Psychological distress

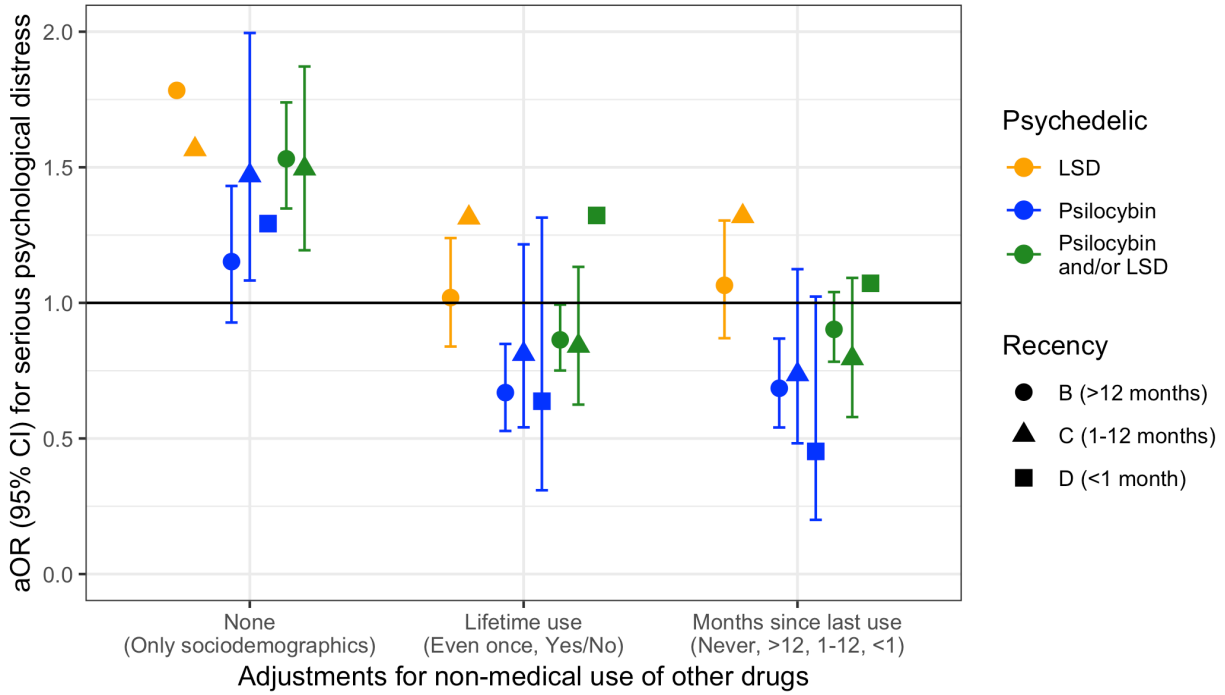

Figure 4. Association between serious psychological distress (during past month) and recency of psychedelic use. Estimates are odds ratios adjusted for gender, race/ethnicity, age, education, marital status, household income, and risk-taking tendency. The second model is additionally adjusted for lifetime non-medical use of cocaine, crack cocaine, heroin, inhalants, pain relievers, tranquilizers, stimulants, sedatives, and ecstasy, while the third model is adjusted for their recency of last use. Both models are also adjusted for past year frequency of alcohol and marijuana use. Values over 1.0 indicate a higher likelihood, and values under 1.0 a lower likelihood, among the group compared to those who have never used psychedelics. Unshown confidence intervals would overlap with all other estimates and were too wide to interpret (see Appendix C).

Before adjustments for non-medical use of other drugs, there was a higher likelihood for past month serious psychological distress among those whose most recent psychedelic use had been with psilocybin and/or LSD over 12 or 1–12 months ago (Figure 4). After adjustments, none of the psychedelic recency groups were associated with a higher likelihood. Instead, those who had taken psilocybin and/or LSD (or psilocybin only) over 12 months ago had a lower likelihood for past month serious psychological distress when adjusting for the lifetime non-medical use of

other substances. For the psilocybin-only (over 12 months ago) group, this lower likelihood was also present when adjusting for the recency of other non-medical drug use.

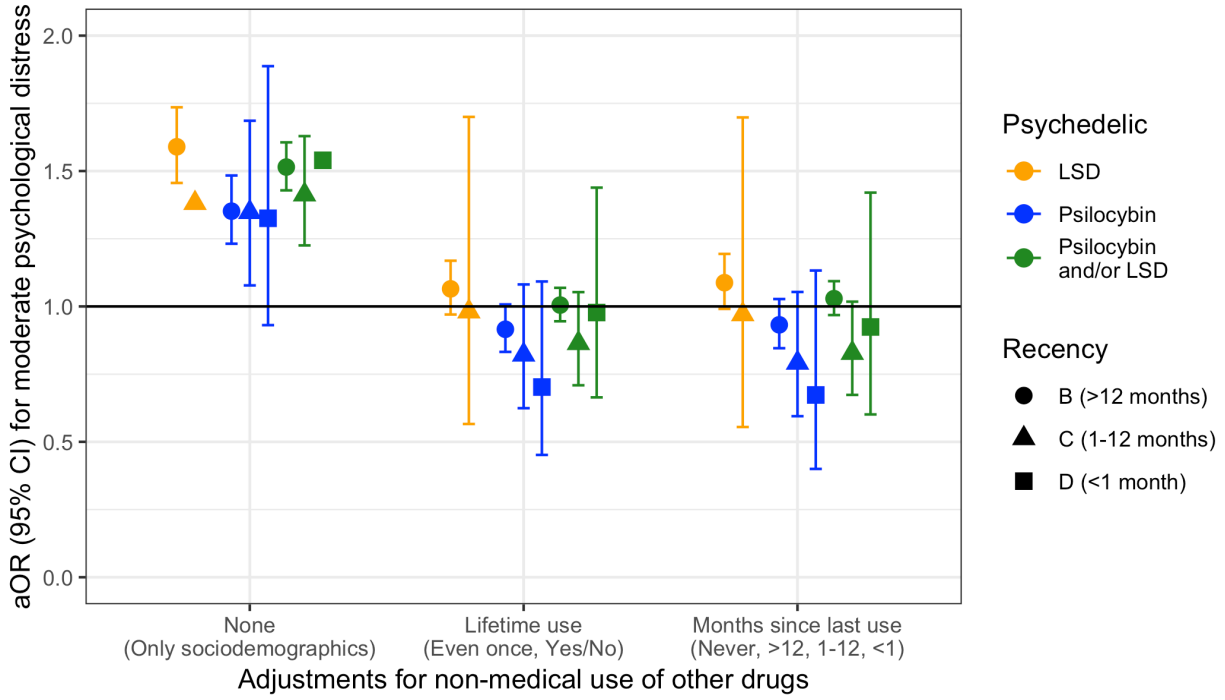

Figure 5. Association between moderate psychological distress (during past month) and recency of psychedelic use. Estimates are odds ratios adjusted for gender, race/ethnicity, age, education, marital status, household income, and risk-taking tendency. The second model is additionally adjusted for lifetime non-medical use of cocaine, crack cocaine, heroin, inhalants, pain relievers, tranquilizers, stimulants, sedatives, and ecstasy, while the third model is adjusted for their recency of last use. Both models are also adjusted for past year frequency of alcohol and marijuana use. Values over 1.0 indicate a higher likelihood, and values under 1.0 a lower likelihood, among the group compared to those who have never used psychedelics. Unshown confidence intervals would overlap with all other estimates and were too wide to interpret (see Appendix C).

For moderate psychological distress during the past month, there was a higher likelihood among five of the psychedelic recency groups before adjusting for non-medical use of other drugs (Figure 5). These were each of the groups whose last psychedelic use was over 12 months ago as well as those who had most recently taken psilocybin and/or LSD, or psilocybin only, 1–12 months ago. After adjusting for other non-medical drug use, none of the psychedelic recency groups were associated with a higher nor lower likelihood for past month moderate psychological distress.

3.2. Everyday impairment

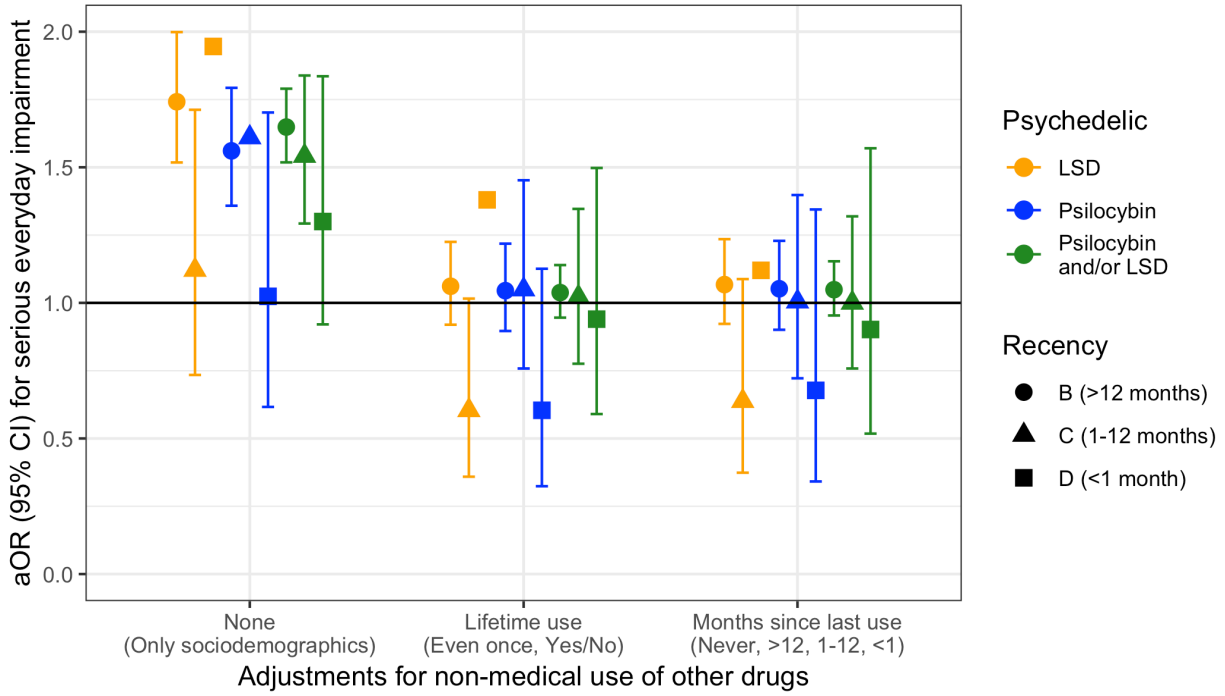

Figure 6. Association between serious everyday impairment (during worst month of past year) and recency of psychedelic use. Estimates are odds ratios adjusted for gender, race/ethnicity, age, education, marital status, household income, and risk-taking tendency. The second model is additionally adjusted for lifetime non-medical use of cocaine, crack cocaine, heroin, inhalants, pain relievers, tranquilizers, stimulants, sedatives, and ecstasy, while the third model is adjusted for their recency of last use. Both models are also adjusted for past year frequency of alcohol and marijuana use. Values over 1.0 indicate a higher likelihood, and values under 1.0 a lower likelihood, among the group compared to those who have never used psychedelics. Unshown confidence intervals would overlap with all other estimates and were too wide to interpret (see Appendix C).

Before adjusting for non-medical use of other drugs, a higher likelihood for serious everyday impairment (during the emotionally worst month of the past year) was found among four of the psychedelic recency groups (Figure 6). These were each of the groups whose last psychedelic use was over 12 months ago (a pattern similar to the associations with past month moderate psychological distress) as well as those who had most recently taken psilocybin and/or LSD 1–12 months ago (present in both the serious and moderate past month psychological distress analyses). After adjusting for other non-medical drug use, none of the psychedelic recency groups were associated with a higher nor lower likelihood for serious everyday impairment during the emotionally worst month of the past year.

3.3. Suicidality

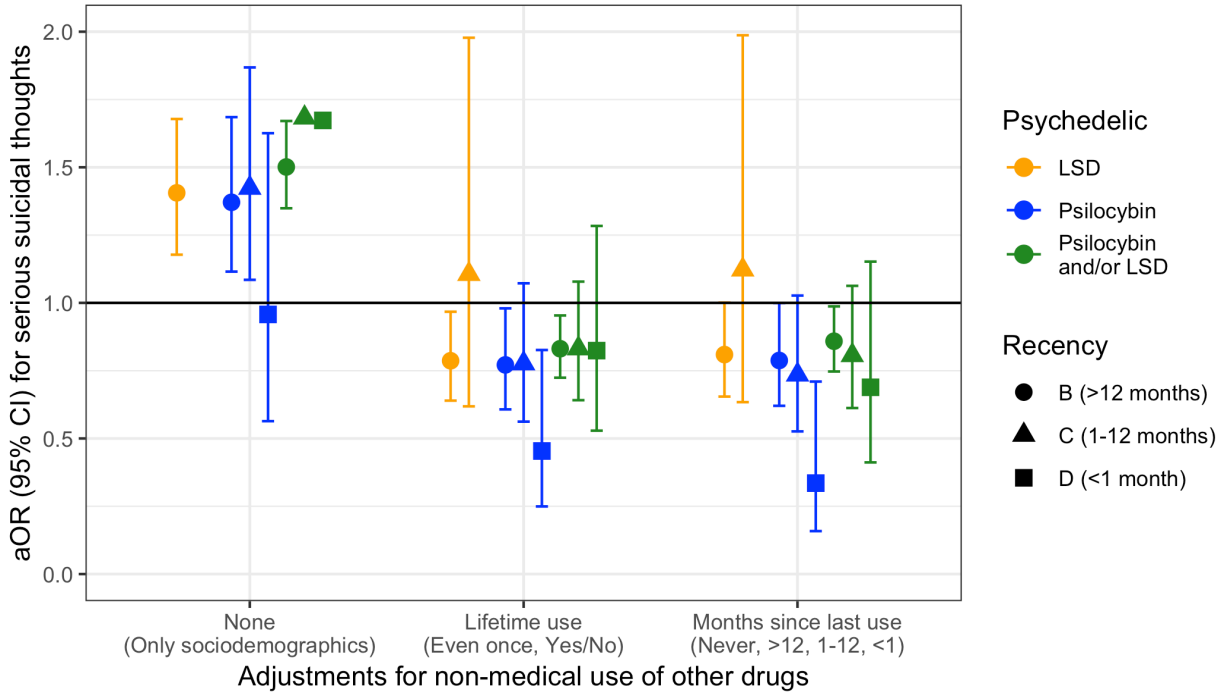

Figure 7. Association between suicidal thinking (during past year) and recency of psychedelic use. Estimates are odds ratios adjusted for gender, race/ethnicity, age, education, marital status, household income, and risk-taking tendency. The second model is additionally adjusted for lifetime non-medical use of cocaine, crack cocaine, heroin, inhalants, pain relievers, tranquilizers, stimulants, sedatives, and ecstasy, while the third model is adjusted for their recency of last use. Both models are also adjusted for past year frequency of alcohol and marijuana use. Values over 1.0 indicate a higher likelihood, and values under 1.0 a lower likelihood, among the group compared to those who have never used psychedelics. Unshown confidence intervals would overlap with all other estimates and were too wide to interpret (see Appendix C).

Before adjusting for non-medical use of other drugs, there was a higher likelihood for past year serious suicidal thoughts among four of the psychedelic recency groups (Figure 7). These were each of the groups whose last psychedelic use was over 12 months ago as well as those who had most recently taken psilocybin 1–12 months ago. After adjusting for other non-medical drug use, there was instead a lower likelihood for past year serious suicidal thoughts among all of those who had most recently taken psychedelics over 12 months ago. In addition, the most visible lower likelihood was associated with the group who had taken psilocybin less than one month ago, though its 95% confidence interval tended to overlap with those of the other lower likelihood groups except for the one of psilocybin and/or LSD in the recency-adjusted model.

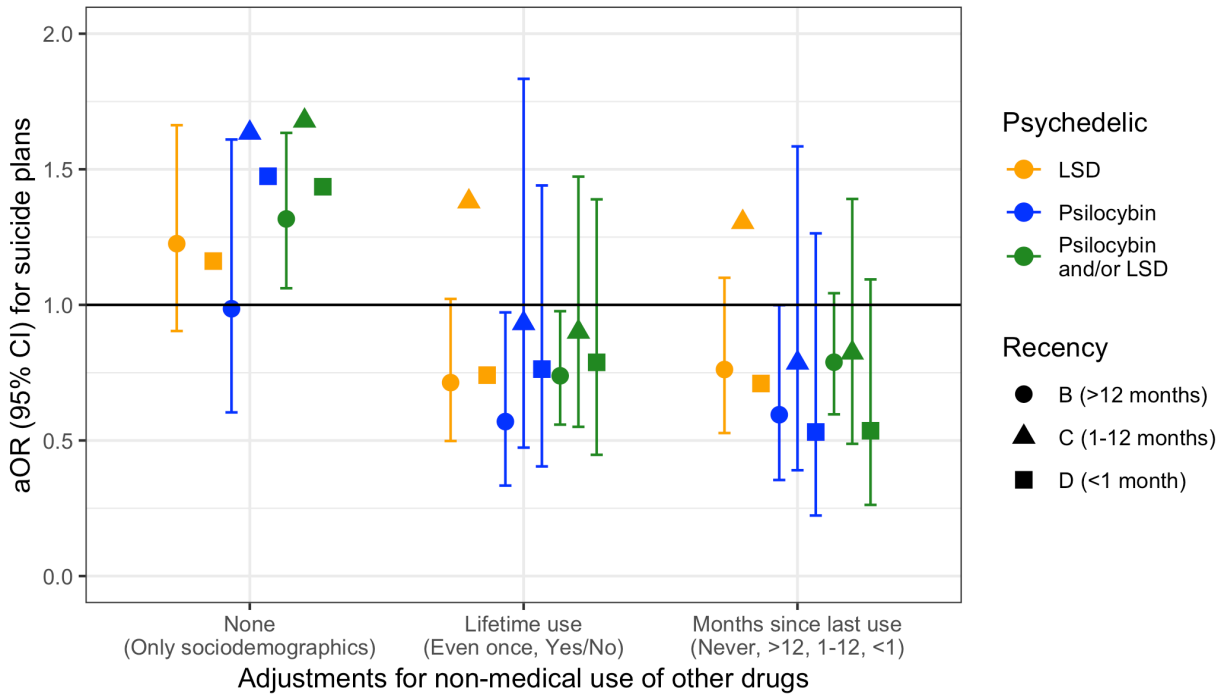

Figure 8. Association between suicide plans (during past year) and recency of psychedelic use. Estimates are odds ratios adjusted for gender, race/ethnicity, age, education, marital status, household income, and risk-taking tendency. The second model is additionally adjusted for lifetime non-medical use of cocaine, crack cocaine, heroin, inhalants, pain relievers, tranquilizers, stimulants, sedatives, and ecstasy, while the third model is adjusted for their recency of last use. Both models are also adjusted for past year frequency of alcohol and marijuana use. Values over 1.0 indicate a higher likelihood, and values under 1.0 a lower likelihood, among the group compared to those who have never used psychedelics. Unshown confidence intervals would overlap with all other estimates and were too wide to interpret (see Appendix C).

For past year suicide plans, there was a higher likelihood only among those whose last psychedelic use was psilocybin and/or LSD over 12 months ago and only before adjusting for other non-medical drug use (Figure 8). After adjusting for non-medical use of other drugs, there was a lower likelihood for past year suicide plans among those who had taken psilocybin over 12 months ago as well as (in the lifetime use model) psilocybin and/or LSD over 12 months ago. No independent associations were found between any of the psychedelic recency groups and a higher likelihood for past year suicide plans after adjusting for non-medical use of other drugs.

For past year (unsuccessful) suicide attempt and recency of psychedelic use, there were no clear associations regardless of adjustments (Figure 9). The narrowest confidence intervals suggest

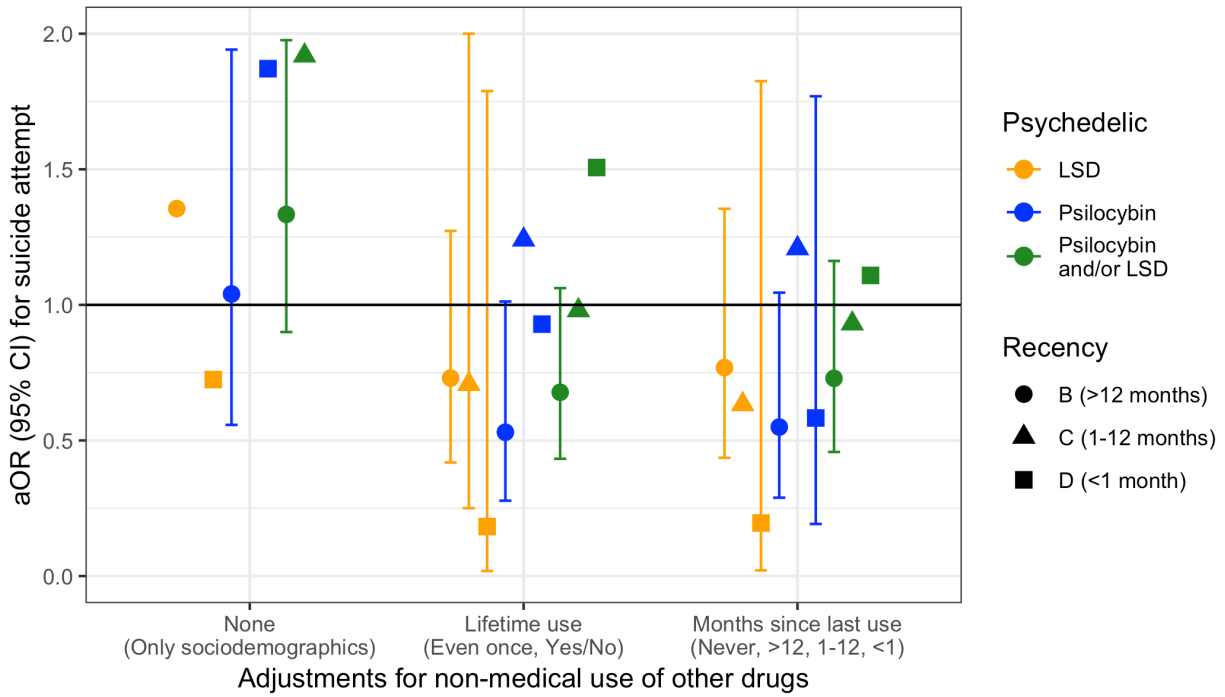

Figure 9. Association between suicide attempt (during past year) and recency of psychedelic use. Estimates are odds ratios adjusted for gender, race/ethnicity, age, education, marital status, household income, and risk-taking tendency. The second model is additionally adjusted for lifetime non-medical use of cocaine, crack cocaine, heroin, inhalants, pain relievers, tranquilizers, stimulants, sedatives, and ecstasy, while the third model is adjusted for their recency of last use. Both models are also adjusted for past year frequency of alcohol and marijuana use. Values over 1.0 indicate a higher likelihood, and values under 1.0 a lower likelihood, among the group compared to those who have never used psychedelics. Unshown confidence intervals would overlap with all other estimates and were too wide to interpret (see Appendix C).

that those whose last psychedelic use was psilocybin and/or LSD (or psilocybin only) over 12 months ago might have a lower likelihood in a larger sample, but no associations were present here. Many of the confidence intervals were too wide to interpret.

3.4. Analysis of overadjustment bias

In the analysis of overadjustment bias, each of the crack cocaine and heroin recency groups was associated with a higher likelihood of past month serious psychological distress (compared to those who had never used crack cocaine or heroin, respectively) before adjusting for non-medical use of other drugs (Table 2). More recent use was associated with a higher likelihood of past month serious psychological distress. After adjusting for the lifetime non-medical use (even

once, Yes/No) of other drugs, there was still a higher likelihood for past month serious psychological distress in all of the groups except for those whose last heroin use was over 12 months ago. Again, there was a trend of more recent use being associated with a higher likelihood, although for this model the 95% confidence intervals were more overlapping. After adjusting for the recency of non-medical use of other drugs, the group whose last heroin use was over 12 months ago was associated with a higher likelihood for past month serious psychological distress while none of the other groups were associated with a higher nor lower likelihood for past month serious psychological distress. Across all of the models, none of the crack cocaine nor heroin recency groups were associated with a lower likelihood for past month serious psychological distress.

Table 2. Association between serious psychological distress and recencies of crack cocaine and heroin use by adjustments for other drug use.

Adjustments for non-medical use of other drugs	**aOR (95% CI) for past month serious psychological distress**					
	Crack cocaine recency (months since last use)			Heroin recency (months since last use)		
	>12 months	1–12 months	<1 month	>12 months	1–12 months	<1 month
None	**2.22 (2.01–2.46)**	**2.82 (2.20–3.61)**	**4.41 (3.29–5.91)**	**2.02 (1.76–2.32)**	**3.30 (2.52–4.34)**	**5.96 (4.51–7.89)**
Lifetime use	**1.28 (1.13–1.45)**	**1.53 (1.17–2.00)**	**2.57 (1.81–3.63)**	0.92 (0.80–1.06)	**1.41 (1.06–1.88)**	**2.53 (1.92–3.35)**
Months since last use	1.17 (0.97–1.41)	1.25 (0.76–2.07)	2.06 (0.92–4.60)	**1.37 (1.02–1.85)**	1.28 (0.72–2.27)	1.46 (0.77–2.74)

Note: Estimates are weighted odds ratios with 95% confidence intervals adjusted for gender, race/ethnicity, age, education, marital status, household income, and risk-taking tendency. The second model is additionally adjusted for lifetime non-medical use of cocaine, inhalants, stimulants, tranquilizers, pain relievers, heroin / crack cocaine, sedatives, psilocybin, LSD, and ecstasy, while the third model is adjusted for months (Never, >12, 1–12, <1) since their most recent non-medical use, with the one difference that psychedelic adjustments in the third model were done by adjusting for the psilocybin and/or LSD group membership. This was due to sample sizes in the LSD-only group which prevented the adjustment of psilocybin and LSD recency groups separately. Both models are also adjusted for past year frequency of alcohol and marijuana use. Values over 1.0 indicate a higher likelihood, and values under 1.0 a lower likelihood, among the group compared to those who have never used crack cocaine / heroin. Findings in bold are significant.

4. Discussion

In a time when psychedelic-assisted treatment is being researched for a variety of indications,[3–13] it is important to reevaluate the psychological safety profile of psychedelics in anticipation of possible increase in their recreational use. Informed by previous population studies as well as by clinical research with sustained treatment effects at long-term follow-ups, this study analyzed the associations between the recency of non-medical psilocybin and LSD use and everyday impairment, past month psychological distress, and past year suicidality. The analysis was based on adult respondents of the National Survey on Drug Use and Health (NSDUH) representative of the population of the United States between years 2008 and 2014.[26]

Consistent with previous research,[16–19] no independent associations were found between psychedelic use and an increased likelihood of any of these indicators of mental distress. On the contrary, after adjusting for differences in sociodemographics, risk-taking tendency, and non-medical use of other drugs, some psychedelic recency groups were associated with a decreased likelihood for past month serious psychological distress, past year serious suicidal thinking, and past year suicide plans (all consistent with previous results,[18] especially for psilocybin[19]). Similar adjustments did not cause crack cocaine or heroin use recency to be associated with a decreased likelihood for past month serious psychological distress, addressing a previously expressed methodological concern[21] that the protective associations found with the adjustments used by the present and previous NSDUH-based population studies would result from overadjustment bias[20].

Specifically, a decreased risk for past year serious suicidal thinking was found among all groups whose most recent psychedelic use was over 12 months ago (with the addition of those who had taken psilocybin less than 1 month ago). This leaves open the possibility of a causal explanation for this temporal association as the psychedelic use in these lower-risk groups predominantly precedes the period where suicidality was reduced. In hindsight, the hypothesis of more recent psychedelic use being associated with reduced past year suicidality did not account for the fact that initially higher suicidality during the past year might conceivably lead some individuals to seek help from self-medication with psychedelics during the past year or the past month. It is possible that in individual cases some people may be less suicidal and some more suicidal after using psychedelics and that statistically these would cancel each other out indicating only a lack of association at the population level. (Naturally, altered beliefs, cognition, or perception during

high-dose recreational psychedelic use may increase risk of accidents unrelated to suicidality per se, which is a harm reduction consideration worth emphasizing when mentioning safety under controlled clinical conditions and this lack of population associations with increased suicidality.)

As a continuation of previous population studies on psychedelics and mental distress, this study made the additional hypothesis and finding that classic psychedelic use was not an independent risk factor for serious everyday impairment. Moreover, while previous population studies focused on the lifetime use of psychedelics (even once, Yes/No), this study confirmed that the recency of psychedelic use (over 12 months ago, between 1 and 12 months ago, or less than 1 month ago) did not appear to be an independent risk factor for any of these indicators of mental distress, either. This was a timely and important addition, as clinical research suggests that even a single administration of psychedelics like psilocybin may be followed by changes sustained over 12 months later, while the lifetime use criterion includes recent users but also everyone whose most recent psychedelic use was many years or even decades ago. Consequently, the present study is a strong affirmation of the findings of the previous population studies, because an increased risk from psychedelic use per se would be expected to be present when focusing specifically on the most recent psychedelic users, as was done here.

In an analysis for the possible presence of an overadjustment bias (Table 2), mirroring adjustments were made to see whether crack cocaine and heroin use recency would be associated with past month serious psychological distress in a manner similar to the psychedelic recency groups. Crack cocaine and heroin were, unlike psychedelics, still associated with a higher likelihood for past month serious psychological distress even after adjusting for the lifetime non-medical use of other drugs. There was also a consistent trend for both crack cocaine and heroin of more recent use being associated with a higher risk for past month serious psychological distress. Overall, this was expected considering that an expert drug harms analysis from 2010 evaluated crack cocaine and heroin as the most harmful drugs to individuals while psilocybin mushrooms and LSD were among the least harmful drugs to individuals.[39]

Furthermore, a pooled analysis of NSDUH years 2008–2013 found that a history of classic psychedelic use is associated with a 27% reduced risk of past year opioid dependence and 40% reduced risk of past year opioid abuse after adjusting for sociodemographics and lifetime non-medical use of other drugs (adjustments almost identical to the lifetime use-adjusting model in

this study).[40] Of the other drugs, only marijuana is associated with a reduced risk of past year opioid abuse while the rest are largely associated with an increased risk of past year opioid dependence and abuse.[40] Therefore, the direction of causality from psychedelic use to other drug use might be more realistically presumed to be the opposite ("protective") of what would lead to overadjustment (an increase in the use of other drugs following the use of psychedelics),[19] especially when accounting for the promising research of classic psychedelics as adjuncts in treating alcohol and tobacco dependence.[3–5,41] The safety, potential, and mechanisms of psychedelics in reducing opioid-related problems is itself an important area of study, as opioid-related deaths are a leading public health problem in the United States, having increased by 345% between the years 2001 and 2016 (from 9,489 to 42,245 deaths).[42]

Surprisingly, the between-substances comparison of recent (1–12 months ago or <1 month ago) LSD use with recent psilocybin use was practically not possible due to wide confidence intervals in the much smaller LSD-only groups preventing odds ratio interpretation. It was unexpected that excluding psilocybin use from the LSD groups would make them so small despite the lifetime prevalence of LSD and psilocybin use being almost identical.[15] Possibly the psilocybin-only groups were much larger because of a more common preference for using the shorter-acting and mushroom-produced psilocybin (seen conceivably as more natural, easier to identify, or less dangerous) while avoiding the extremely potent LSD, compared to a preference of using only LSD and avoiding ever trying psilocybin. In any case, future studies focusing specifically on recent use of LSD but no other classic psychedelics might benefit from retaining the LSD-only sample size by still allowing history of psilocybin use before that time period, as was done with regard to history of ecstasy and phencyclidine use for all the more recent groups in this study.

Finally, the results were hypothesized to differ depending on which set of adjustments was used in accounting for the non-medical use of other drugs (none, lifetime use, or their recency of use). Side-by-side comparisons with the minimally adjusted model clearly show how the choice to not adjust for other drug use confounds the data and hides the independent association between psychedelic use and mental health. However, between the latter two models the psychedelic recency groups would always have closely overlapping confidence intervals, indicating that the previous studies based on NSDUH data would not substantially differ even had they used adjustments for the recency of non-medical use of other drugs.

Before adjustments for other drug use, it seemed that the highest risks (confounded by other drug use) were among those whose psychedelic use was the least recent (largely over 12 months ago; never less than 1 month ago). This could be explained by hidden differences that might not be possible to account for with the present data alone, including: Did they have a longer history of non-medical drug use in general? What were their psychedelic experiences like? What were their motivations for having used psychedelics then but not again? Presumably at least some irregular users might have had negative experiences causing them to avoid further use, while in many cases the benefits of even positive experiences might not be sustained were the actual recency many years or decades ago (compared to the more recent groups of 1–12 or <1 months ago where possible beneficial effects may last for months). Naturally, the history of other non-medical drug use (unaccounted for in the minimally adjusted model) might result in complex differences, including social support and friendship differences that are important but hard to adequately quantify in public use data sets to begin with. A further challenge comes from a cross-cultural survey indicating that psychedelic users, compared to users of nonpsychedelic drugs, score higher on mystical beliefs (e.g., oneness with God and the universe), life values relating to spirituality and concern for others, and general coping ability,[43] all of which are conceivably related to how one experiences psychological distress and suicidality.

The protective associations found in this and some of the previous population studies are not surprising when considering that psychedelics are related to beneficial psychological changes in both clinical and recreational use. A review of 77 studies with 9876 participants points out that clinical, ceremonial, and recreational use of psychedelics have all been described, evaluated, and measured by using concepts from positive psychology: "Psychedelics [...] were shown to produce acute and long-term effects on mood, well-being, prosocial behaviours, empathy, cognitive flexibility, creativity, personality factors like openness, value orientations, nature-relatedness, spirituality, self-transendence and mindfulness-related capabilities."[44] These may be the upsides of psychedelics, explaining why humans have used them since written history,[2] why they may play an important role in alleviating a variety of treatment-resistant conditions,[3–13] and why the experiences are consistently and sustainably attributed with great personal meaning and spiritual significance.[4,5] Presumably, any of these factors could mediate any of the relationships between psychedelic use and the indicators of mental distress investigated in this study.

References

1. Grinspoon L, Bakalar JB. *Psychedelic Drugs Reconsidered*. New York: Basic Books; 1979.

2. Nichols DE. Psychedelics. *Pharmacological Reviews*. 2016;68(2):264-355. doi:10.1124/pr.115.011478

3. Bogenschutz MP, Forcehimes AA, Pommy JA, Wilcox CE, Barbosa P, Strassman RJ. Psilocybin-assisted treatment for alcohol dependence: A proof-of-concept study. *Journal of Psychopharmacology*. 2015;29(3):289-299. doi:10.1177/0269881114565144

4. Johnson MW, Garcia-Romeu A, Cosimano MP, Griffiths RR. Pilot study of the 5-HT2AR agonist psilocybin in the treatment of tobacco addiction. *Journal of Psychopharmacology*.2014;11.

5. Johnson MW, Garcia-Romeu A, Griffiths RR. Long-term follow-up of psilocybin-facilitated smoking cessation. *The American Journal of Drug and Alcohol Abuse*. 2017;43(1):55-60. doi:10.3109/00952990.2016.1170135

6. Carhart-Harris RL, Bolstridge M, Rucker J, et al. Psilocybin with psychological support for treatment-resistant depression: an open-label feasibility study. *The Lancet Psychiatry*. 2016;3(7):619-627. doi:10.1016/S2215-0366(16)30065-7

7. Carhart-Harris RL, Bolstridge M, Day CMJ, et al. Psilocybin with psychological support for treatment-resistant depression: six-month follow-up. *Psychopharmacology*. 2018;235(2):399-408. doi:10.1007/s00213-017-4771-x

8. Watts R, Day C, Krzanowski J, Nutt D, Carhart-Harris R. Patients' Accounts of Increased "Connectedness" and "Acceptance" After Psilocybin for Treatment-Resistant Depression. *Journal of Humanistic Psychology*. 2017;57(5):520-564. doi:10.1177/0022167817709585

9. Grob CS, Danforth AL, Chopra GS, et al. Pilot Study of Psilocybin Treatment for Anxiety in Patients With Advanced-Stage Cancer. *Archives of General Psychiatry*. 2011;68(1):71. doi:10.1001/archgenpsychiatry.2010.116

10. Griffiths RR, Johnson MW, Carducci MA, et al. Psilocybin produces substantial and sustained decreases in depression and anxiety in patients with life-threatening cancer: A randomized double-blind trial. *Journal of Psychopharmacology*. 2016;30(12):1181-1197. doi:10.1177/0269881116675513

11. Ross S, Bossis A, Guss J, et al. Rapid and sustained symptom reduction following psilocybin treatment for anxiety and depression in patients with life-threatening cancer: a randomized controlled trial. *Journal of Psychopharmacology*. 2016;30(12):1165-1180. doi:10.1177/0269881116675512

12. Gasser P, Holstein D, Michel Y, et al. Safety and Efficacy of Lysergic Acid Diethylamide-Assisted Psychotherapy for Anxiety Associated With Life-threatening Diseases: *The Journal*

of Nervous and Mental Disease. 2014;202(7):513-520. doi:10.1097/NMD.0000000000000113

13. Gasser P, Kirchner K, Passie T. LSD-assisted psychotherapy for anxiety associated with a life-threatening disease: A qualitative study of acute and sustained subjective effects. *Journal of Psychopharmacology*. 2015;29(1):57-68. doi:10.1177/0269881114555249

14. Majić T, Schmidt TT, Gallinat J. Peak experiences and the afterglow phenomenon: When and how do therapeutic effects of hallucinogens depend on psychedelic experiences? *Journal of Psychopharmacology*. 2015;29(3):241-253. doi:10.1177/0269881114568040

15. Krebs, T. S., Johansen, P. Ø. Over 30 million psychedelic users in the United States. *F1000Research*, 2013;2.

16. Krebs TS, Johansen P-Ø. Psychedelics and Mental Health: A Population Study. Lu L, ed. *PLoS ONE*. 2013;8(8):e63972. doi:10.1371/journal.pone.0063972

17. Johansen P-Ø, Krebs TS. Psychedelics not linked to mental health problems or suicidal behavior: A population study. *Journal of Psychopharmacology*. 2015;29(3):270-279. doi:10.1177/0269881114568039

18. Hendricks PS, Thorne CB, Clark CB, Coombs DW, Johnson MW. Classic psychedelic use is associated with reduced psychological distress and suicidality in the United States adult population. *Journal of Psychopharmacology*. 2015;29(3):280-288. doi:10.1177/0269881114565653

19. Hendricks PS, Johnson MW, Griffiths RR. Psilocybin, psychological distress, and suicidality. *Journal of Psychopharmacology*. 2015;29(9):1041-1043. doi:10.1177/0269881115598338

20. Schisterman EF, Cole SR, Platt RW. Overadjustment Bias and Unnecessary Adjustment in Epidemiologic Studies: *Epidemiology*. 2009;20(4):488-495. doi:10.1097/EDE.0b013e3181a819a1

21. Nesvåg R, Bramness JG, Ystrom E. The link between use of psychedelic drugs and mental health problems. *Journal of Psychopharmacology*. 2015;29(9):1035-1040. doi:10.1177/0269881115596156

22. Unger SM. Mescaline, LSD, Psilocybin, and Personality Change a Review †. *Psychiatry*. 1963;26(2):111-125. doi:10.1080/00332747.1963.11023344

23. MacLean KA, Johnson MW, Griffiths RR. Mystical experiences occasioned by the hallucinogen psilocybin lead to increases in the personality domain of openness. *Journal of Psychopharmacology*. 2011;25(11):1453-1461. doi:10.1177/0269881111420188

24. Erritzoe D, Roseman L, Nour MM, et al. Effects of psilocybin therapy on personality structure. *Acta Psychiatrica Scandinavica*. 2018;138(5):368-378. doi:10.1111/acps.12904

25. National Survey on Drug Use and Health (NSDUH). *About the Survey*. National Survey on Drug Use and Health website. https://nsduhweb.rti.org/respweb/about_nsduh.html. Accessed 1 December, 2018.

26. Substance Abuse & Mental Health Data Archive (SAMHDA). *National Survey on Drug Use and Health (NSDUH-2002-2015)*. National Survey on Drug Use and Health website. https://www.datafiles.samhsa.gov/study/national-survey-drug-use-and-health-nsduh-2002-2015-nid17101. Updated 21 March, 2018. Accessed 20 August, 2018.

27. Kessler RC, Barker PR, Colpe LJ, et al. Screening for Serious Mental Illness in the General Population. *Archives of General Psychiatry*. 2003;60(2):184. doi:10.1001/archpsyc.60.2.184

28. American Psychiatry Association. *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)*. 1994. American Psychiatry Association, Washington, DC.

29. Prochaska JJ, Sung H-Y, Max W, Shi Y, Ong M. Validity study of the K6 scale as a measure of moderate mental distress based on mental health treatment need and utilization: The K6 as a measure of moderate mental distress. *International Journal of Methods in Psychiatric Research*. 2012;21(2):88-97. doi:10.1002/mpr.1349

30. Novak SP, Colpe LJ, Barker PR, Gfroerer JC. Development of a brief mental health impairment scale using a nationally representative sample in the USA. *International Journal of Methods in Psychiatric Research*. 2010;19(S1):49-60. doi:10.1002/mpr.313

31. Aldworth J, Colpe LJ, Gfroerer JC, et al. The National Survey on Drug Use and Health Mental Health Surveillance Study: calibration analysis. *International Journal of Methods in Psychiatric Research*. 2010;19(S1):61-87. doi:10.1002/mpr.312

32. Han B, Compton WM, Gfroerer J, McKeon R. Prevalence and Correlates of Past 12-Month Suicide Attempt Among Adults With Past-Year Suicidal Ideation in the United States. *The Journal of Clinical Psychiatry*. 2015;76(03):295-302. doi:10.4088/JCP.14m09287

33. R Core Team (2017). R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-Project.org/.

34. RStudio Team (2015). RStudio: Integrated Development for R. RStudio, Inc., Boston, MA URL http://www.rstudio.com/.

35. Hadley Wickham (2017). Tidyverse: Easily Install and Load the "tidyverse". R Package Version 1.2.1. https://CRAN.R-Project.org/package=tidyverse.

36. Mehrad Mahmoudian (2018). Varhandle: Functions for Robust Variable Handling. R Package Version 2.0.3. https://CRAN.R-Project.org/package=varhandle.

37. T. Lumley (2018) "Survey: Analysis of Complex Survey Samples". R Package Version 3.34.

38. Lumley T. Analysis of Complex Survey Samples. *Journal of Statistical Software*. 2004;9(8). doi:10.18637/jss.v009.i08

39. Nutt DJ, King LA, Phillips LD. Drug harms in the UK: a multicriteria decision analysis. *The Lancet*. 2010;376(9752):1558-1565. doi:10.1016/S0140-6736(10)61462-6

40. Pisano VD, Putnam NP, Kramer HM, Franciotti KJ, Halpern JH, Holden SC. The association of psychedelic use and opioid use disorders among illicit users in the United States. *Journal of Psychopharmacology*. 2017;31(5):606-613. doi:10.1177/0269881117691453

41. Krebs TS, Johansen P-Ø. Lysergic acid diethylamide (LSD) for alcoholism: meta-analysis of randomized controlled trials. *Journal of Psychopharmacology*. 2012;26(7):994-1002. doi:10.1177/0269881112439253

42. Gomes T, Tadrous M, Mamdani MM, Paterson JM, Juurlink DN. The Burden of Opioid-Related Mortality in the United States. *JAMA Network Open*. 2018;1(2):e180217. doi:10.1001/jamanetworkopen.2018.0217

43. Lerner M, Lyvers M. Values and Beliefs of Psychedelic Drug Users: A Cross-Cultural Study. *Journal of Psychoactive Drugs*. 2006;38(2):143-147. doi:10.1080/02791072.2006.10399838

44. Jungaberle H, Thal S, Zeuch A, et al. Positive psychology in the investigation of psychedelics and entactogens: A critical review. *Neuropharmacology*. June 2018. doi:10.1016/j.neuropharm.2018.06.034

45. Tupper KW, Wood E, Yensen R, Johnson MW. Psychedelic medicine: a re-emerging therapeutic paradigm. *Canadian Medical Association Journal*. 2015;187(14):1054-1059. doi:10.1503/cmaj.141124

Appendices

Appendix A. Lifetime non-medical use of substances within each group

Table A1. Lifetime non-medical use of substances within each psychedelic recency group.

	Psychedelic group									
	Never used	**Psilocybin and/or LSD**			**Psilocybin**			**LSD**		
Recency (months)		>12	1–12	<1	>12	1–12	<1	>12	1–12	<1
Unweighted *N*	220925	11846	1888	462	4556	980	213	4006	182	39
Substance	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
Psilocybin	0.0	57.2	91.0	83.9	100.0	100.0	100.0	0.0	0.0	0.0
LSD	0.0	70.5	50.3	56.0	0.0	0.0	0.0	100.0	100.0	100.0
PCP	0.0	0.0	4.8	7.6	0.0	2.1	5.3	0.0	0.0	5.6
Ecstasy	0.0	0.0	41.7	51.1	0.0	24.2	39.9	0.0	27.0	25.7
Cigarettes	62.9	93.2	92.0	94.3	91.3	89.0	94.3	93.4	86.7	95.6
Snuff tobacco	11.0	30.7	44.2	42.1	32.0	43.9	37.7	23.4	25.8	32.9
Chew tobacco	10.8	29.0	34.0	30.0	29.8	30.9	28.7	21.9	20.9	20.1
Pipe tobacco	12.4	24.9	31.6	28.1	23.7	27.6	29.6	22.8	30.3	7.4
Alcohol	85.2	99.3	99.5	99.8	99.3	99.5	99.8	99.1	99.4	100.0
Marijuana	35.4	97.2	98.1	99.7	96.5	96.8	99.3	96.7	97.4	100.0
Cocaine	6.4	57.7	53.4	56.9	47.8	41.6	49.9	54.2	38.7	40.6
Crack cocaine	1.0	11.4	11.7	8.5	5.2	6.2	8.3	11.5	2.9	10.6
Heroin	0.3	3.9	6.7	5.2	1.5	2.7	6.2	4.7	2.5	0.8
Inhalants	3.2	28.4	35.6	34.2	24.7	23.4	39.4	22.5	26.0	13.3
Pain relievers	8.6	31.7	57.4	57.9	32.7	51.0	61.7	26.9	40.4	31.7
Tranquilizers	4.5	24.3	43.9	46.0	22.9	36.2	42.9	22.4	22.8	25.2
Stimulants	3.3	25.4	35.0	28.1	20.9	27.2	18.6	23.4	26.1	15.9
Sedatives	1.1	10.1	4.6	3.9	8.1	3.3	2.1	10.6	1.8	1.0

Note: wt%: weighted proportion of group. PCP: phencyclidine.

Appendix B. Unweighted outcome proportions within each group before adjustments

Table B1. Unweighted outcome proportions within each group before adjustments.

Psychedelic group		Suicidal thinking		Suicide plans		Suicide attempt		Everyday impairment		Serious psychological distress		Moderate psychological distress	
N	Recency (months)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)
Never used psychedelics													
220925		95.1	4.6	98.3	1.3	98.9	0.7	79.1	14.0	94.3	5.8	63.9	36.1
Psilocybin and/or LSD													
11846	>12	93.3	6.4	98.0	1.7	99.0	0.7	72.2	20.5	92.6	7.4	56.5	43.5
1888	1–12	87.6	12.1	95.4	4.2	97.3	2.3	69.1	23.8	89.6	10.4	48.0	52.0
462	<1	86.4	13.6	94.8	5.2	96.8	3.3	69.1	24.0	84.6	15.4	45.0	55.0
Psilocybin													
4556	>12	93.6	6.2	98.1	1.7	99.1	0.6	73.2	19.9	93.4	6.6	56.3	43.7
980	1–12	88.1	11.5	96.0	3.6	97.5	2.1	69.5	22.9	89.7	10.3	49.7	50.3
213	<1	88.3	11.7	93.4	6.6	97.7	2.4	68.1	24.9	85.9	14.1	45.5	54.5
LSD													
4006	>12	93.4	6.3	97.9	1.8	98.9	0.8	71.2	21.1	91.3	8.7	56.2	43.8
182	1–12	83.0	16.5	91.2	8.2	94.5	5.0	69.2	26.4	85.7	14.3	45.1	55.0
39	<1	79.5	20.5	94.9	5.1	97.4	2.6	59.0	35.9	66.7	33.3	38.5	61.5

Note: Outcomes are (left to right): past year suicidal thinking, suicide plans, and suicide attempt; serious everyday impairment during the emotionally worst month of past year; and serious/moderate psychological distress during the past month.

Appendix C. Weighted and adjusted odds ratios for each group and outcome

Table C1. Weighted and adjusted odds ratios with 95% confidence intervals for each group and outcome.

Psychedelic group		Suicidal thinking	Suicide plans	Suicide attempt	Everyday impairment	Serious psychological distress	Moderate psychological distress
N	Recency (months)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)
Never used psychedelics							
220925		*reference*	*reference*	*reference*	*reference*	*reference*	*reference*
Psilocybin and/or LSD							
11846	>12	**0.86 (0.75–0.99)**	0.79 (0.60–1.04)	0.73 (0.46–1.16)	1.05 (0.95–1.15)	0.90 (0.78–1.04)	1.03 (0.97–1.09)
1888	1–12	0.81 (0.61–1.06)	0.82 (0.49–1.39)	0.93 (0.41–2.14)	1.00 (0.76–1.32)	0.80 (0.58–1.09)	0.83 (0.67–1.02)
462	<1	0.69 (0.41–1.15)	0.54 (0.26–1.09)	1.11 (0.49–2.53)	0.90 (0.52–1.57)	1.07 (0.57–2.03)	0.92 (0.60–1.42)
Psilocybin							
4556	>12	**0.79 (0.62–1.00)**	**0.59 (0.35–1.00)**	0.55 (0.29–1.05)	1.05 (0.90–1.23)	**0.69 (0.54–0.87)**	0.93 (0.85–1.03)
980	1–12	0.74 (0.53–1.03)	0.79 (0.39–1.58)	1.21 (0.48–3.04)	1.00 (0.72–1.40)	0.74 (0.48–1.12)	0.79 (0.59–1.05)
213	<1	**0.34 (0.16–0.71)**	0.53 (0.22–1.26)	0.58 (0.19–1.77)	0.68 (0.34–1.34)	0.45 (0.20–1.02)	0.67 (0.40–1.13)
LSD							
4006	>12	**0.81 (0.65–1.00)**	0.76 (0.53–1.10)	0.77 (0.44–1.35)	1.07 (0.92–1.24)	1.06 (0.87–1.30)	1.09 (0.99–1.19)
182	1–12	1.12 (0.63–1.99)	1.30 (0.59–2.88)	0.63 (0.20–2.04)	0.64 (0.37–1.09)	1.32 (0.71–2.46)	0.97 (0.55–1.70)
39	<1	2.28 (0.65–7.95)	0.71 (0.14–3.68)	0.20 (0.02–1.83)	1.12 (0.49–2.55)	4.15 (1.52–11.34)	2.70 (0.38–19.08)

Note: All estimates are adjusted for gender, race/ethnicity, age, education, marital status, household income, risk-taking tendency, past year frequency of alcohol and marijuana use, as well as for months (Never, >12, 1–12, <1) since the most recent non-medical use of cocaine, crack cocaine, heroin, inhalants, pain relievers, tranquilizers, stimulants, sedatives, and ecstasy. Values over 1.0 indicate a higher likelihood, and values under 1.0 a lower likelihood, among the group compared to those who have never used psychedelics. Outcomes are (left to right): past year suicidal thinking, suicide plans, and suicide attempt; serious everyday impairment during the emotionally worst month of past year; and serious/moderate psychological distress during the past month. Findings in bold are significant.

Appendix D. Full R code

```
#### master.R (run everything)
# # load data
# d <- load("NSDUH_2002_2015.rdata")
# d <- concatenatedpuf_0215_032118

# sessionInfo()
# R version 3.4.1 (2017-06-30)
# Other attached packages:
# varhandle_2.0.3 forcats_0.3.0   stringr_1.3.1   dplyr_0.7.6
# purrr_0.2.5     readr_1.1.1     tidyr_0.8.1     tibble_1.4.2
# ggplot2_3.0.0   tidyverse_1.2.1 survey_3.34     survival_2.41-3
# Matrix_1.2-10

library(survey) # for weighting
library(tidyverse)
library(varhandle)

# Set data, groups, counts, and functions.
source("set_s.R")
source("set_groups.R")
source("set_counts.R")
source("set_functions.R")

# Different dataset for each outcome analysis, retaining maximum N in the
rest:
s.thnk <- filter(s,
  suicthnk!=-9,suicthnk!=85,suicthnk!=89,suicthnk!=94,suicthnk!=97,
  suicthnk!=98,suicthnk!=99) %>%
  mutate(suicthnk = case_when(suicthnk==1 ~ TRUE, suicthnk==2 ~ FALSE))

s.plan <- filter(s,
  suicplan!=-9,suicplan!=85,suicplan!=89,suicplan!=94,suicplan!=97,
  suicplan!=98,suicplan!=99) %>%
  mutate(suicplan = case_when(suicplan==1 ~ TRUE, suicplan==2 ~ FALSE))

s.try <- filter(s,
  suictry!=-9,suictry!=85,suictry!=89,suictry!=94,suictry!=97,
  suictry!=98,suictry!=99) %>%
  mutate(suictry = case_when(suictry==1 ~ TRUE, suictry==2 ~ FALSE))

s.WHODAS <- filter(s, WHODASC3 != -9)

s.K6 <- filter(s, K6SCMON != -9)

# Output descriptive statistics
# source("descr.R") # unweighted
source("descr_W.R") # weighted
```

```
# Run binomial regression for suicidality (thoughts, plans, attempt), K6≥13,
K6≥5, and WHODASC3≥3.
source("suicthnk.R")
source("suicplan.R")
source("suictry.R")
source("K6_13.R")
source("K6_5.R")
source("WHODAS.R")

# Run combined outcome table (TRUEs, FALSEs, and aORs+CIs by subgroup).
source("outcomes.R")

# Run analysis of overadjustment bias (using crk & her as predictors)
source("OAB.R")

# Cleaning tool:
# # Lines to remove... (ctrl+shift+C to block [un]comment)
# rm(plottable, xlabels, x)       # helpers: plottable, xlabels, x
# rm(list=ls(pattern="oab"))      # overadjustment bias objects
# rm(list=ls(pattern="c."))       # subgroup count (incl. weighted wc.)
objects
# rm(list=ls(pattern=".n"))       # absolute count objects (n)
# rm(list=ls(pattern=".prop"))    # proportion count objects (%)
# rm(list=ls(pattern=".both"))    # abs+prop ("both") objects (n + %)
# rm(list=ls(pattern="outcomes")) # outcome objects
# rm(list=ls(pattern="OR"))       # Odds Ratio (OR) objects
# rm(list=ls(pattern="desg"))     # survey design objects
# rm(list=ls(pattern="s."))       # filtered versions of data
# rm(s)                           # dataset of selected variables from d
```

```
#### set_s.R (subset only necessary variables from the data)
#### # SELECT VARIABLES
s <- dplyr::select(d, year, vestr, verep, ANALWC7, # <- weighting
# NSDUH-defined hallucinogens:
lsd, psilcy, peyote, mesc, pcp, ecstasy, halnolst,
# Recencies ("how long since last use"). All collected for 2008-2014:
hallrec, lsdrec, pcprec, ecsrec, irlsdrc, irpcprc, ircocrc, ircrkrc, irherrc,
irinhrc, iranlrc, irtrnrc, irstmrc, irsedrc,
# Common drugs (lifetime ever used yes or no):
cigever, snfever, chewever, pipever, alcever, mjever,
# Other drugs/categories whose lifetime non-medical use will be adjusted:
cocever, crkever, herever, inhever, anlever, trnever, stmever, sedever,
K6SCMON, WHODASC3, suicthnk, suicplan, suictry, # <- outcome variables
# Control variables (age, education, sex, race/ethnicity, marital status,
household income, risky behavior):
CATAG7, EDUCCAT2, irsex, NEWRACE2, irmarit, income, rkfqrsky,
# Quantitative control variables (past year freq of alcohol and marijuana)
iralcfy, irmjfy) %>%
# EXCLUDE OBS WITH BAD DATA ON NECESSARY VARIABLES
filter(rkfqrsky!=85, rkfqrsky!=94, rkfqrsky!=97, rkfqrsky!=98,
lsd!=85,psilcy!=85,peyote!=85,mesc!=85,pcp!=85,ecstasy!=85,halnolst!=85,
hallrec!=85, lsdrec!=85, pcprec!=85, ecsrec!=85,
snfever!=85, chewever!=85, pipever!=85, alcever!=85, mjever!=85, cocever!=85,
crkever!=85, herever!=85) %>%
# EXCLUDE YEARS WITHOUT OUTCOME VARIABLE K6SCMON
filter(year!=2002, year!=2003, year!=2004, year!=2005, year!=2006,
year!=2007, year!=2015) # (leaving seven years: 2008-2014)

# COLLAPSE FACTOR LEVELS
# Factorize variables that were integers straight from NSDUH (for collapsing
and regression models)
cols<-c("lsd","psilcy","peyote","mesc","pcp","ecstasy","halnolst",
"hallrec","lsdrec","pcprec","ecsrec",
"cigever","snfever","chewever","pipever","alcever","mjever","cocever","crkeve
r","herever","inhever","anlever","trnever","stmever","sedever",
"ircocrc","ircrkrc","irherrc","irinhrc","iranlrc","irtrnrc","irstmrc","irsedr
c",
"irsex","NEWRACE2","irmarit","income","rkfqrsky","CATAG7","EDUCCAT2")
s[cols] <- lapply(s[cols], factor)
rm(cols)

# Collapse lifetime-use factor levels into yes/no/other/DNCFTY ("Data Not
Collected For This Year"), and recencies into
Past1/Ov1_Un12/Ov12/sometime_past12mo/sometime_life/never/other/DNCFTY:
s <- s %>% mutate(
lsd=fct_collapse(lsd,
  yes=c("1","3"), no=c("2","91"), other=c("94","97")),
psilcy=fct_collapse(psilcy,
  yes=c("1","3"), no=c("2","91"), other=c("94","97")),
peyote=fct_collapse(peyote,
```

```
  yes=c("1","3"), no=c("2","91"), other=c("94","97")),
mesc=fct_collapse(mesc,
  yes=c("1","3"), no=c("2","91"), other=c("94","97")),
pcp=fct_collapse(pcp,
  yes=c("1","3"), no=c("2","91"), other=c("94","97")),
ecstasy=fct_collapse(ecstasy,
  yes=c("1","3"), no=c("2","91"), other=c("94","97"), DNCFTY=c("-9")),
cigever=fct_collapse(cigever,
  yes=c("1"), no=c("2")),
snfever=fct_collapse(snfever,
  yes=c("1"), no=c("2"), other=c("94","97"), DNCFTY=c("-9")),
chewever=fct_collapse(chewever,
  yes=c("1"), no=c("2"), other=c("94","97"), DNCFTY=c("-9")),
pipever=fct_collapse(pipever,
  yes=c("1"), no=c("2"), other=c("94","97")),
alcever=fct_collapse(alcever,
  yes=c("1"), no=c("2"), other=c("94","97")),
mjever=fct_collapse(mjever,
  yes=c("1"), no=c("2"), other=c("94","97")),
cocever=fct_collapse(cocever,
  yes=c("1"), no=c("2"), other=c("94","97")),
crkever=fct_collapse(crkever,
  yes=c("1"), no=c("2","91","81"), other=c("94","97","98")),
herever=fct_collapse(herever,
  yes=c("1"), no=c("2"), other=c("94","97")),
inhever=fct_collapse(inhever,
  yes=c("1"), no=c("91"), other=c("97","98"), DNCFTY=c("-9")),
anlever=fct_collapse(anlever,
  yes=c("1"), no=c("91","81"), other=c("97","98"), DNCFTY=c("-9")),
trnever=fct_collapse(trnever,
  yes=c("1"), no=c("91","81"), other=c("97","98"), DNCFTY=c("-9")),
stmever=fct_collapse(stmever,
  yes=c("1"), no=c("91","81"), other=c("94","97","98"), DNCFTY=c("-9")),
sedever=fct_collapse(sedever,
  yes=c("1"), no=c("91","81"), other=c("94","97","98"), DNCFTY=c("-9")),
halnolst=fct_collapse(halnolst,
  yes=c("1","3"), no=c("2","91"), other=c("94","97"), DNCFTY=c("-9")),
hallrec=fct_collapse(hallrec, Past1=c("1","11"), Ov1_Un12=c("2","12"),
  Ov12=c("3"), sometime_past12mo=c("8"), sometime_life=c("9"),
  never=c("91"), other=c("97","98"), DNCFTY=c("-9")),
lsdrec=fct_collapse(lsdrec, Past1=c("1","11"), Ov1_Un12=c("2"),
  Ov12=c("3"), sometime_past12mo=c("8"), sometime_life=c("9"),
  never=c("91"), other=c("97","98")),
pcprec=fct_collapse(pcprec, Past1=c("1","11"), Ov1_Un12=c("2"),
  Ov12=c("3"), sometime_past12mo=c("8"), sometime_life=c("9"),
  never=c("91"), other=c("97","98")),
ecsrec=fct_collapse(ecsrec, Past1=c("1","11"), Ov1_Un12=c("2"),
  Ov12=c("3"), sometime_past12mo=c("8"), sometime_life=c("9"),
  never=c("91"), other=c("97","98"), DNCFTY=c("-9")))
```

```
# EXCLUDE OBS WITH UNKNOWN HALL RECENCIES ("sometime_past12mo",
"sometime_life", "other", "DNCFTY"),
s <- filter(s, hallrec!="sometime_past12mo", hallrec!="sometime_life",
              hallrec!="other",             hallrec!="DNCFTY",
 lsdrec!="sometime_past12mo",  lsdrec!="sometime_life",  lsdrec!="other",
 pcprec!="sometime_past12mo",  pcprec!="sometime_life",  pcprec!="other",
 ecsrec!="sometime_past12mo",  ecsrec!="sometime_life",  ecsrec!="other",
 ecsrec!="DNCFTY") # Leaving 4 values: past mo, 1-12 mo, >12 mo, never

# Create continuous freq variables for past year alcohol/marijuana use by
recoding the values "never used" (991) and "none during past year" (993) both
into 0.
s <- mutate(s,
alcfreq=case_when(iralcfy==991~0,iralcfy==993~0,TRUE~as.double(iralcfy)),
mrjfreq=case_when( irmjfy==991~0, irmjfy==993~0,TRUE~as.double( irmjfy)))

# Create cutoff points K6SCMON ≥ 13 and 5 for past month serious and moderate
psychological distress respectively, as used in previous research, for
binomial logistic regression.
s <- mutate(s,K6_Ov12=case_when( K6SCMON>=13~TRUE, K6SCMON<13~FALSE),
              K6_Ov4=case_when( K6SCMON >=5~TRUE, K6SCMON< 5~FALSE),
# Create cutoff point WHODASC3 ≥ 3 for impairment in daily activities during
worst month of past year. This should be comparable in seriousness to using
13 for the K6 (Aldworth et al. 2010).
           WHODAS_Ov3=case_when(WHODASC3>=3~TRUE,WHODASC3<3~FALSE))

# Count past year suicidal plans and past year suicide attempt as 'No' if
# past year suicidal thoughts was 'No'
s <- mutate(s,
suicplan=case_when(suicthnk==2~2,TRUE~as.double(suicplan)),
 suictry=case_when(suicthnk==2~2,TRUE~as.double(suictry)))

# Keep only observations whose age is at least 18.
s <- filter(s, CATAG7!=1, CATAG7!=2, CATAG7!=3)
```

```
#### set_groups.R (infer psychedelic recency groups)
# CREATE THREE GROUPS FOR LAST USE OF (1) INCLUSIVE PSILOCYBIN/LSD, (2)
PSILO, & (3) LSD - EXCLUDING ALL OTHER HALLUCINOGEN USE DURING THE TIME
PERIOD: B: >12 months ago [exclusion = never].
#       C: 1-12 months ago [exclusion period = past year],
#       D: during past month [exclusion period = past month],

# PSILOCYBIN/LSD GROUP, 4 values:
s <- mutate(s, PL.gr = case_when(
# (1)
  hallrec == "never" ~ "A", # Never used a hallucinogen.
# (2)
 halnolst == "no"                         # Never any unlisted hallucinogen
&  peyote == "no"    &   mesc == "no"    # Never peyote nor mescaline
&  pcprec == "never" & ecsrec == "never" # Never PCP nor ecstasy
& hallrec == "Ov12"                      # Yes a hallucinogen last time
                                         # >12 months ago
&    (lsd == "yes" | psilcy == "yes")    # Yes LSD or psilocybin (and no
                                         # other hallucinogen)...
          ~ "B",                   # last time >12 months ago.
# (3)
 halnolst == "no"                       # Never any unlisted hallucinogen
&  peyote == "no" & mesc == "no"       # Never peyote nor mescaline
&  pcprec != "Ov1_Un12"                # No     PCP during past 12 months
&  pcprec != "Past1"                   # (n worse w/ "never")
&  ecsrec != "Ov1_Un12"                # No ecstasy during past 12 months
&  ecsrec != "Past1"                   # (n worse w/ "never")
& hallrec == "Ov1_Un12"                # Yes a hallucinogen last time 1-12
                                       # months ago
&    (lsd == "yes" | psilcy == "yes") # Yes LSD or psilocybin (and no
                                       # other hallucinogen)...
          ~ "C",                # last time 1-12 months ago.
# (4)
 halnolst == "no"                       # Never any unlisted hallucinogen
&  peyote == "no" & mesc == "no"       # Never peyote nor mescaline
&  pcprec != "Past1"                   # No     PCP during past month
                                       # (n worse w/ "never")
&  ecsrec != "Past1"                   # No ecstasy during past month
                                       # (n worse w/ "never")
& hallrec == "Past1"                   # Yes a hallucinogen last time
                                       # during past month
&    (lsd == "yes" | psilcy == "yes") # Yes LSD or psilocybin (and no
                                       # other hallucinogen)...
          ~ "D"))               # last time during past month.

# PSILOCYBIN GROUP, 4 values:
s <- mutate(s, P.gr = case_when(
# (1)
  hallrec == "never" ~ "A", # Never used a hallucinogen.
# (2)
```

```
 halnolst == "no"    &    lsd == "no"    # Never any unlisted hallucinogen
                                         # nor LSD
&  peyote == "no"    &   mesc == "no"    # Never peyote nor mescaline
&  pcprec == "never" & ecsrec == "never" # Never PCP nor ecstasy
& hallrec == "Ov12"                      # Yes a hallucinogen last time
                                         # >12 months ago
&  psilcy == "yes"                      # Yes psilocybin (and no other
                                         # hallucinogen)...
          ~ "B",                   # last time >12 months ago.
# (3)
 halnolst == "no" &  lsd == "no" # Never any unlisted hallucinogen nor LSD
&  peyote == "no" & mesc == "no" # Never peyote nor mescaline
&  pcprec != "Ov1_Un12"          # No     PCP during past 12 months
&  pcprec != "Past1"             # (n worse w/ "never")
&  ecsrec != "Ov1_Un12"          # No ecstasy during past 12 months
&  ecsrec != "Past1"             # (n worse w/ "never")
& hallrec == "Ov1_Un12"          # Yes a hallucinogen last time 1-12
                                 # months ago
&  psilcy == "yes"               # Yes psilocybin (and no other
                                 # hallucinogen)...
          ~ "C",           # last time 1-12 months ago.
# (4)
 halnolst == "no" &  lsd == "no" # Never any unlisted hallucinogen nor LSD
&  peyote == "no" & mesc == "no" # Never peyote nor mescaline
&  pcprec != "Past1"             # No     PCP during past month
                                 # (n worse w/ "never")
&  ecsrec != "Past1"             # No ecstasy during past month
                                 # (n worse w/ "never")
& hallrec == "Past1"             # Yes a hallucinogen last time during
                                 # past month
&  psilcy == "yes"               # Yes psilocybin (and no other
                                 # hallucinogen)...
          ~ "D"))          # last time during past month.

# LSD GROUP, 4 values:
s <- mutate(s, L.gr = case_when(
# (1)
 hallrec == "never" ~ "A", # Never used a hallucinogen.
# (2)
halnolst == "no"    & psilcy == "no"    # Never any unlisted hallucinogen
                                        # nor psilocybin
& peyote == "no"    &   mesc == "no"    # Never peyote nor mescaline
& pcprec == "never" & ecsrec == "never" # Never PCP nor ecstasy
& lsdrec == "Ov12"                      # Yes LSD (and no other
                                        # hallucinogen)
         ~ "B",                  # last time >12 months ago.
# (3)
halnolst == "no" & psilcy == "no" # Never any unlisted hallucinogen
                                  # nor psilocybin
& peyote == "no" &   mesc == "no" # Never peyote nor mescaline
```

```
& pcprec != "Ov1_Un12"            # No     PCP during past 12 months
& pcprec != "Past1"               # (n worse w/ "never")
& ecsrec != "Ov1_Un12"            # No ecstasy during past 12 months
& ecsrec != "Past1"               # (n worse w/ "never")
& lsdrec == "Ov1_Un12"            # Yes LSD (and no other hallucinogen)
         ~ "C",             # last time 1-12 months ago.
# (4)
halnolst == "no" & psilcy == "no" # Never any unlisted hallucinogen
                                  # nor psilocybin
& peyote == "no" &   mesc == "no" # Never peyote nor mescaline
& pcprec != "Past1"               # No     PCP during past month
& ecsrec != "Past1"               # No ecstasy during past month
& lsdrec == "Past1"               # Yes LSD (and no other hallucinogen)
         ~ "D"))            # last time during past month.
```

```
#### set_counts.R (compute & save group counts)
## Group counts:
# Create a single row for group counts:
(group_counts <- cbind(count(s,PL.gr), count(s,P.gr), count(s,L.gr)))
(gc.row <- c(group_counts[2:4,2], group_counts[2:4,4], group_counts[2:4,6]))
# BCD, BCD, BCD
# A = never, B = over 12 months ago, C = 1-12 months ago, D = past month
(c.A <- group_counts[1,2])
(c.PL.B <- gc.row[1])
(c.PL.C <- gc.row[2])
(c.PL.D <- gc.row[3])
(c.P.B  <- gc.row[4])
(c.P.C  <- gc.row[5])
(c.P.D  <- gc.row[6])
(c.L.B  <- gc.row[7])
(c.L.C  <- gc.row[8])
(c.L.D  <- gc.row[9])

# Weighted group counts:
# Add a variable that indicates the survey design
options(survey.lonely.psu = "adjust")
desg <- svydesign(id=~verep, strata=~vestr, weights=~ANALWC7, data=s,
nest=TRUE)
#
(wc.PL <- svytable(~PL.gr  +PL.gr, desg)) # ABCD
(wc.P <- svytable(~P.gr  +P.gr, desg)) # ABCD
(wc.L <- svytable(~L.gr  +L.gr, desg)) # ABCD
(wc.PL.B <- as.double(wc.PL[2]))
(wc.PL.C <- as.double(wc.PL[3]))
(wc.PL.D <- as.double(wc.PL[4]))
(wc.P.B <- as.double(wc.P[2]))
(wc.P.C <- as.double(wc.P[3]))
(wc.P.D <- as.double(wc.P[4]))
(wc.L.B <- as.double(wc.L[2]))
(wc.L.C <- as.double(wc.L[3]))
(wc.L.D <- as.double(wc.L[4]))
(wc.A <- as.double(wc.PL[1]))

# Create a single row for weighted group counts
(gwc.row <- as.vector(round(
  c(wc.PL[2:4], wc.P[2:4], wc.L[2:4]), 0))) # BCD, BCD, BCD
```

```
#### set_functions.R (set custom functions used by other scripts)
ORs <- function(m){return(cbind(
  exp(   coef(m)),
  exp(summary(m)$coefficients[,1] - 1.96*summary(m)$coefficients[,2]),
  exp(summary(m)$coefficients[,1] + 1.96*summary(m)$coefficients[,2])))
}

group_ORs <- function(ors){
  gors <- rbind(ors["PL.grB",], ors["PL.grC",], ors["PL.grD",],
                ors[ "P.grB",], ors[ "P.grC",], ors[ "P.grD",],
                ors[ "L.grB",], ors[ "L.grC",], ors[ "L.grD",])
  rownames(gors) <- c("Psilocybin\nand/or LSD",
                      "Psilocybin\nand/or LSD",
                      "Psilocybin\nand/or LSD",
                      "Psilocybin",
                      "Psilocybin",
                      "Psilocybin",
                      "LSD",
                      "LSD",
                      "LSD")
  colnames(gors) <- c("Odds Ratio", "Lower(2.5%)", "Upper(97.5%)")
  return(gors)
}

plot_all_ORs <- function(minad.gors, life.gors, rec.gors, label){
OR.all <- rbind(
  cbind(  minad.gors, c("None\n(Only sociodemographics)")),
  cbind(   life.gors, c("Lifetime use\n(Even once, Yes/No)")),
  cbind(    rec.gors, c("Months since last use\n(Never, >12, 1-12, <1)")))
# Add rownames as a column (for ggplot color):
OR.all <- cbind(OR.all, rownames(minad.gors))
rownames(OR.all) <- c()
# Add recencies as a column (for ggplot shape):
OR.all <- cbind(OR.all,
                c("B (>12 months)", "C (1-12 months)", "D (<1 month)"))
# Make it a data frame with numbers, not factors (for ggplot):
OR.all <- as.data.frame(OR.all)
OR.all[,1] <- unfactor(OR.all[,1])
OR.all[,2] <- unfactor(OR.all[,2])
OR.all[,3] <- unfactor(OR.all[,3])
OR.all[,4] <- unfactor(OR.all[,4])
colnames(OR.all) <-
  c("OR", "lower", "upper", "adjustments", "Psychedelic", "Recency")

# Plot ORs with 95% CIs for all models & groups:
ggplot(OR.all, aes(
  x = factor(adjustments,
             levels=c("None\n(Only sociodemographics)",
                      "Lifetime use\n(Even once, Yes/No)",
                      "Months since last use\n(Never, >12, 1-12, <1)")),
```

```
  y = OR,
  color = Psychedelic,
  shape = Recency)) +
geom_errorbar(aes(ymin=lower, ymax=upper),
              width=.4, position=position_dodge(0.6)) +
geom_point(size=3, position=position_dodge(0.6)) +
geom_hline(yintercept=1, color="black") +
theme_bw() +
scale_colour_manual(values=c("orange", "blue", "forestgreen")) +
ylim(0,2) +
ylab(label) +
xlab("Adjustments for non-medical use of other drugs")
}
```

```
#### descr.R (descriptive statistics, unweighted)
### CROSSTAB & PLOT WITHIN-SUBGROUP PROPORTIONS OF OTHER LIFETIME-USE
VARIABLES
## Counts (n) of lifetime=yes per subgroup:
# PL:
life.n.PL <- rbind(
  table(s$psilcy  , s$PL.gr)[1,], table(s$lsd     , s$PL.gr)[1,],
  table(s$pcp     , s$PL.gr)[1,], table(s$ecstasy , s$PL.gr)[1,],
  table(s$cigever , s$PL.gr)[1,], table(s$snfever , s$PL.gr)[1,],
  table(s$chewever, s$PL.gr)[1,], table(s$pipever , s$PL.gr)[1,],
  table(s$alcever , s$PL.gr)[1,], table(s$mjever  , s$PL.gr)[1,],
  table(s$cocever , s$PL.gr)[1,], table(s$crkever , s$PL.gr)[1,],
  table(s$herever , s$PL.gr)[1,], table(s$inhever , s$PL.gr)[1,],
  table(s$anlever , s$PL.gr)[1,], table(s$trnever , s$PL.gr)[1,],
  table(s$stmever , s$PL.gr)[1,], table(s$sedever , s$PL.gr)[1,])
rownames(life.n.PL) <- c("psilo", "lsd", "pcp", "ecstasy", "ciga", "snuf",
"chew", "pipe", "alco", "mari", "coca", "crack", "hero", "inha", "pain",
"tran", "stim", "seda")
# P:
life.n.P <- rbind(
  table(s$psilcy  , s$P.gr)[1,],  table(s$lsd     , s$P.gr)[1,],
  table(s$pcp     , s$P.gr)[1,],  table(s$ecstasy , s$P.gr)[1,],
  table(s$cigever , s$P.gr)[1,],  table(s$snfever , s$P.gr)[1,],
  table(s$chewever, s$P.gr)[1,],  table(s$pipever , s$P.gr)[1,],
  table(s$alcever , s$P.gr)[1,],  table(s$mjever  , s$P.gr)[1,],
  table(s$cocever , s$P.gr)[1,],  table(s$crkever , s$P.gr)[1,],
  table(s$herever , s$P.gr)[1,],  table(s$inhever , s$P.gr)[1,],
  table(s$anlever , s$P.gr)[1,],  table(s$trnever , s$P.gr)[1,],
  table(s$stmever , s$P.gr)[1,],  table(s$sedever , s$P.gr)[1,])
rownames(life.n.P) <- c("psilo", "lsd", "pcp", "ecstasy", "ciga", "snuf",
"chew", "pipe", "alco", "mari", "coca", "crack", "hero", "inha", "pain",
"tran", "stim", "seda")
# L:
life.n.L <- rbind(
  table(s$psilcy  , s$L.gr)[1,], table(s$lsd     , s$L.gr)[1,],
  table(s$pcp     , s$L.gr)[1,], table(s$ecstasy , s$L.gr)[1,],
  table(s$cigever , s$L.gr)[1,], table(s$snfever , s$L.gr)[1,],
  table(s$chewever, s$L.gr)[1,], table(s$pipever , s$L.gr)[1,],
  table(s$alcever , s$L.gr)[1,], table(s$mjever  , s$L.gr)[1,],
  table(s$cocever , s$L.gr)[1,], table(s$crkever , s$L.gr)[1,],
  table(s$herever , s$L.gr)[1,], table(s$inhever , s$L.gr)[1,],
  table(s$anlever , s$L.gr)[1,], table(s$trnever , s$L.gr)[1,],
  table(s$stmever , s$L.gr)[1,], table(s$sedever , s$L.gr)[1,])
rownames(life.n.L) <- c("psilo", "lsd", "pcp", "ecstasy", "ciga", "snuf",
"chew", "pipe", "alco", "mari", "coca", "crack", "hero", "inha", "pain",
"tran", "stim", "seda")
# All combined:
life.n <- cbind(life.n.PL, life.n.P, life.n.L)
colnames(life.n) <- c("A", "PL.B", "PL.C", "PL.D", "A", "P.B", "P.C", "P.D",
"A", "L.B", "L.C", "L.D")
```

```
## Proportions (%) of lifetime=yes per subgroup

(life.prop <- life.n) # n. counts / group count
(life.prop[, 1] <- round(life.n[, 1]/c.A,    3))
(life.prop[, 2] <- round(life.n[, 2]/c.PL.B, 3))
(life.prop[, 3] <- round(life.n[, 3]/c.PL.C, 3))
(life.prop[, 4] <- round(life.n[, 4]/c.PL.D, 3))
(life.prop[, 5] <- round(life.n[, 5]/c.A,    3))
(life.prop[, 6] <- round(life.n[, 6]/c.P.B,  3))
(life.prop[, 7] <- round(life.n[, 7]/c.P.C,  3))
(life.prop[, 8] <- round(life.n[, 8]/c.P.D,  3))
(life.prop[, 9] <- round(life.n[, 9]/c.A,    3))
(life.prop[,10] <- round(life.n[,10]/c.L.B,  3))
(life.prop[,11] <- round(life.n[,11]/c.L.C,  3))
(life.prop[,12] <- round(life.n[,12]/c.L.D,  3))
(life.prop <- life.prop*100)

# Remove two redundant "never" columns:
life.n    <- life.n[,-5]
life.n    <- life.n[,-8]
life.prop <- life.prop[,-5]
life.prop <- life.prop[,-8]

# Add rownames to front (for CSV output):
(life.n    <- cbind(rownames(life.n),    life.n))
(life.prop <- cbind(rownames(life.prop), life.prop))

# Add group counts as the top row
# n:
(life.n.gc <- as.data.frame(rbind(
  c("(group-n ->)", c.A, gc.row),
  life.n)))
# prop:
(life.prop.gc <- as.data.frame(rbind(
  c("(group-n ->)", c.A, gc.row),
  life.prop)))
(life.both <- cbind(life.n.gc, life.prop.gc)) # both

# Output CSV tables:
write_csv(life.n.gc, "life.n.csv")
write_csv(life.prop.gc, "life.prop.csv")
write_csv(life.both[,-12], "life.both.csv") # del redundant rownames col

### Plot within-group lifetime percentages for each group:
(xlabels <- life.prop[,1])

# B (and never):
plottable <- rbind(
  cbind(xlabels, life.prop[,"PL.B"], c("Psilocybin\nand/or LSD")),
```

```
  cbind(xlabels, life.prop[, "P.B"], c("Psilocybin")),
  cbind(xlabels, life.prop[, "L.B"], c("LSD")),
  cbind(xlabels, life.prop[,   "A"], c("Psychedelics:\nNever used")))
colnames(plottable) <- c("lifetime", "prop", "Psychedelic")
plottable     <- as.tibble(plottable)
plottable[,2] <- as.double(unlist(plottable[,2]))

ggplot(plottable, aes(
  x=factor(lifetime, levels=c("psilo", "lsd", "pcp", "ecstasy", "ciga",
"snuf", "chew", "pipe", "alco", "mari","coca", "crack", "hero", "inha",
"pain", "tran", "stim", "seda")),
  y=prop, color=Psychedelic, group=Psychedelic)) +
geom_point() + geom_line() + theme_bw() +
scale_colour_manual(values=c("orange", "blue", "forestgreen", "black")) +
xlab("Lifetime use (even once)") +
ylab("Proportion (%) of group")
ggsave(width=9, height=4, units="in", "life B (>12).png")

# C (and never):
plottable <- rbind(
  cbind(xlabels, life.prop[,"PL.C"], c("Psilocybin\nand/or LSD")),
  cbind(xlabels, life.prop[, "P.C"], c("Psilocybin")),
  cbind(xlabels, life.prop[, "L.C"], c("LSD")),
  cbind(xlabels, life.prop[,   "A"], c("Psychedelics:\nNever used")))
colnames(plottable) <- c("lifetime", "prop", "Psychedelic")
plottable     <- as.tibble(plottable)
plottable[,2] <- as.double(unlist(plottable[,2]))

ggplot(plottable, aes(
  x=factor(lifetime, levels=c("psilo", "lsd", "pcp", "ecstasy", "ciga",
"snuf", "chew", "pipe", "alco", "mari","coca", "crack", "hero", "inha",
"pain", "tran", "stim", "seda")),
  y=prop, color=Psychedelic, group=Psychedelic)) +
geom_point() + geom_line() + theme_bw() +
scale_colour_manual(values=c("orange", "blue", "forestgreen", "black")) +
xlab("Lifetime use (even once)") +
ylab("Proportion (%) of group")
ggsave(width=9, height=4, units="in", "life C (1-12).png")

# D (and never):
plottable <- rbind(
  cbind(xlabels, life.prop[,"PL.D"], c("Psilocybin\nand/or LSD")),
  cbind(xlabels, life.prop[, "P.D"], c("Psilocybin")),
  cbind(xlabels, life.prop[, "L.D"], c("LSD")),
  cbind(xlabels, life.prop[,   "A"], c("Psychedelics:\nNever used")))
colnames(plottable) <- c("lifetime", "prop", "Psychedelic")
plottable     <- as.tibble(plottable)
plottable[,2] <- as.double(unlist(plottable[,2]))

ggplot(plottable, aes(
```

```
  x=factor(lifetime, levels=c("psilo", "lsd", "pcp", "ecstasy", "ciga",
"snuf", "chew", "pipe", "alco", "mari","coca", "crack", "hero", "inha",
"pain", "tran", "stim", "seda")),
  y=prop, color=Psychedelic, group=Psychedelic)) +
geom_point() + geom_line() + theme_bw() +
scale_colour_manual(values=c("orange", "blue", "forestgreen", "black")) +
xlab("Lifetime use (even once)") +
ylab("Proportion (%) of group")
ggsave(width=9, height=4, units="in", "life D (<1).png")

# CROSSTAB WITHIN-SUBGROUP PROPORTIONS (%) OF DEMOGRAPHIC VARIABLES
# (CATAG7, EDUCCAT2, irsex, NEWRACE2, irmarit, income, rkfqrsky):
# CATAG7:
age.n <- cbind(table(s$CATAG7, s$PL.gr),
               table(s$CATAG7, s$P.gr )[,-1],
               table(s$CATAG7, s$L.gr )[,-1])
rownames(age.n) <- c("12-13", "14-15", "16-17", "18-20", "21-25", "26-34",
"35+")
age.prop <- round(prop.table(age.n, 2), 3) * 100
# EDUCCAT2:
edu.n <- cbind(table(s$EDUCCAT2, s$PL.gr),
               table(s$EDUCCAT2, s$P.gr )[,-1],
               table(s$EDUCCAT2, s$L.gr )[,-1])
rownames(edu.n) <- c("Less than high school", "High school graduate", "Some
college", "College graduate", "12 to 17 year olds")
edu.prop <- round(prop.table(edu.n, 2), 3) * 100
# irsex:
sex.n <- cbind(table(s$irsex, s$PL.gr),
               table(s$irsex, s$P.gr )[,-1],
               table(s$irsex, s$L.gr )[,-1])
rownames(sex.n) <- c("Male", "Female")
sex.prop <- round(prop.table(sex.n, 2), 3) * 100
# NEWRACE2:
race.n <- cbind(table(s$NEWRACE2, s$PL.gr),
                table(s$NEWRACE2, s$P.gr )[,-1],
                table(s$NEWRACE2, s$L.gr )[,-1])
rownames(race.n) <- c("NonHisp White", "NonHisp Black/Afr Am", "NonHisp
Native Am/AK Native", "NonHisp Native HI/Other Pac Isl", "NonHisp Asian",
"NonHisp more than one race", "Hispanic")
race.prop <- round(prop.table(race.n, 2), 3) * 100
# irmarit:
mar.n <- cbind(table(s$irmarit, s$PL.gr),
               table(s$irmarit, s$P.gr )[,-1],
               table(s$irmarit, s$L.gr )[,-1])
rownames(mar.n) <- c("Married", "Widowed", "Divorced or Separated", "Never
Been Married", "<= 14 years old")
mar.prop <- round(prop.table(mar.n, 2), 3) * 100
# income:
inc.n <- cbind(table(s$income, s$PL.gr),
               table(s$income, s$P.gr )[,-1],
```

```
               table(s$income, s$L.gr )[,-1])
rownames(inc.n) <- c("< 20,000", "20,000-49,999", "50,000-74,999", "75,000")
inc.prop <- round(prop.table(inc.n, 2), 3) * 100
# rkfqrsky:
risk.n <- cbind(table(s$rkfqrsky, s$PL.gr),
                table(s$rkfqrsky, s$P.gr )[,-1],
                table(s$rkfqrsky, s$L.gr )[,-1])
rownames(risk.n) <- c("Never", "Seldom", "Sometimes", "Always")
risk.prop <- round(prop.table(risk.n, 2), 3) * 100

# All (absolute n):
(demo.n <- rbind(age.n, edu.n, sex.n, race.n, mar.n, inc.n, risk.n))
colnames(demo.n) <- c("A", "PL.B", "PL.C", "PL.D", "P.B", "P.C", "P.D",
"L.B", "L.C", "L.D")
# All (proportions):
(demo.prop <- rbind(age.prop, edu.prop, sex.prop, race.prop, mar.prop,
inc.prop, risk.prop))
colnames(demo.prop) <- c("A", "PL.B", "PL.C", "PL.D", "P.B", "P.C", "P.D",
"L.B", "L.C", "L.D")

# Add rownames to front (for CSV output):
(demo.n    <- cbind(rownames(demo.n),    demo.n))
(demo.prop <- cbind(rownames(demo.prop), demo.prop))

# Add group counts as the top row
# n:
(demo.n  <- as.data.frame(rbind(
  c("(group-n ->)", c.A, gc.row),
  demo.n)))
# prop:
(demo.prop <- as.data.frame(rbind(
  c("(group-n ->)", c.A, gc.row),
  demo.prop)))
(demo.both <- cbind(demo.n, demo.prop)) # both

# Output CSV tables
write_csv(demo.n, "demo.n.csv")
write_csv(demo.prop, "demo.prop.csv")
write_csv(demo.both[,-12], "demo.both.csv") # del redundant rownames col
```

```
#### descr_W.R (descriptive statistics, weighted)
#### # Add a variable that indicates the survey design
options(survey.lonely.psu = "adjust")
desg <- svydesign(id=~verep, strata=~vestr, weights=~ANALWC7, data=s,
nest=TRUE)

### CROSSTAB & PLOT WITHIN-SUBGROUP PROPORTIONS OF OTHER LIFETIME-USE
VARIABLES
## Weighted counts (n) of lifetime=yes per subgroup:
# PL:
life.n.PL <- rbind(
svytable(~psilcy  +PL.gr, desg)[1,],svytable(~lsd     +PL.gr, desg)[1,],
svytable(~pcp     +PL.gr, desg)[1,],svytable(~ecstasy +PL.gr, desg)[1,],
svytable(~cigever +PL.gr, desg)[1,],svytable(~snfever +PL.gr, desg)[1,],
svytable(~chewever+PL.gr, desg)[1,],svytable(~pipever +PL.gr, desg)[1,],
svytable(~alcever +PL.gr, desg)[1,],svytable(~mjever  +PL.gr, desg)[1,],
svytable(~cocever +PL.gr, desg)[1,],svytable(~crkever +PL.gr, desg)[1,],
svytable(~herever +PL.gr, desg)[1,],svytable(~inhever +PL.gr, desg)[1,],
svytable(~anlever +PL.gr, desg)[1,],svytable(~trnever +PL.gr, desg)[1,],
svytable(~stmever +PL.gr, desg)[1,],svytable(~sedever +PL.gr, desg)[1,])
rownames(life.n.PL) <- c("psilo", "lsd", "pcp", "ecst", "ciga", "snuf",
"chew", "pipe", "alco", "mari", "coca", "crack", "hero", "inha", "pain",
"tran", "stim", "seda")
# P:
life.n.P <- rbind(
svytable(~psilcy  +P.gr, desg)[1,],svytable(~lsd     +P.gr, desg)[1,],
svytable(~pcp     +P.gr, desg)[1,],svytable(~ecstasy +P.gr, desg)[1,],
svytable(~cigever +P.gr, desg)[1,],svytable(~snfever +P.gr, desg)[1,],
svytable(~chewever+P.gr, desg)[1,],svytable(~pipever +P.gr, desg)[1,],
svytable(~alcever +P.gr, desg)[1,],svytable(~mjever  +P.gr, desg)[1,],
svytable(~cocever +P.gr, desg)[1,],svytable(~crkever +P.gr, desg)[1,],
svytable(~herever +P.gr, desg)[1,],svytable(~inhever +P.gr, desg)[1,],
svytable(~anlever +P.gr, desg)[1,],svytable(~trnever +P.gr, desg)[1,],
svytable(~stmever +P.gr, desg)[1,],svytable(~sedever +P.gr, desg)[1,])
rownames(life.n.P) <- c("psilo", "lsd", "pcp", "ecst", "ciga", "snuf",
"chew", "pipe", "alco", "mari", "coca", "crack", "hero", "inha", "pain",
"tran", "stim", "seda")
# L:
life.n.L <- rbind(
svytable(~psilcy  +L.gr, desg)[1,],svytable(~lsd     +L.gr, desg)[1,],
svytable(~pcp     +L.gr, desg)[1,],svytable(~ecstasy +L.gr, desg)[1,],
svytable(~cigever +L.gr, desg)[1,],svytable(~snfever +L.gr, desg)[1,],
svytable(~chewever+L.gr, desg)[1,],svytable(~pipever +L.gr, desg)[1,],
svytable(~alcever +L.gr, desg)[1,],svytable(~mjever  +L.gr, desg)[1,],
svytable(~cocever +L.gr, desg)[1,],svytable(~crkever +L.gr, desg)[1,],
svytable(~herever +L.gr, desg)[1,],svytable(~inhever +L.gr, desg)[1,],
svytable(~anlever +L.gr, desg)[1,],svytable(~trnever +L.gr, desg)[1,],
svytable(~stmever +L.gr, desg)[1,],svytable(~sedever +L.gr, desg)[1,])
```

```
rownames(life.n.L) <- c("psilo", "lsd", "pcp", "ecst", "ciga", "snuf",
"chew", "pipe", "alco", "mari", "coca", "crack", "hero", "inha", "pain",
"tran", "stim", "seda")
# All combined:
life.n <- round(cbind(life.n.PL, life.n.P, life.n.L),0)
colnames(life.n) <- c("A", "PL.B", "PL.C", "PL.D", "A", "P.B", "P.C", "P.D",
"A", "L.B", "L.C", "L.D")

## Weighted proportions (%) of lifetime=yes per subgroup

(life.prop <- life.n) # Abs. counts / group count (weighted)
(life.prop[, 1] <- round(life.n[, 1]/wc.A,    3))
(life.prop[, 2] <- round(life.n[, 2]/wc.PL.B, 3))
(life.prop[, 3] <- round(life.n[, 3]/wc.PL.C, 3))
(life.prop[, 4] <- round(life.n[, 4]/wc.PL.D, 3))
(life.prop[, 5] <- round(life.n[, 5]/wc.A,    3))
(life.prop[, 6] <- round(life.n[, 6]/wc.P.B,  3))
(life.prop[, 7] <- round(life.n[, 7]/wc.P.C,  3))
(life.prop[, 8] <- round(life.n[, 8]/wc.P.D,  3))
(life.prop[, 9] <- round(life.n[, 9]/wc.A,    3))
(life.prop[,10] <- round(life.n[,10]/wc.L.B,  3))
(life.prop[,11] <- round(life.n[,11]/wc.L.C,  3))
(life.prop[,12] <- round(life.n[,12]/wc.L.D,  3))
(life.prop <- life.prop*100)

# Remove two redundant "never" columns:
life.n    <- life.n[,-5]
life.n    <- life.n[,-8]
life.prop <- life.prop[,-5]
life.prop <- life.prop[,-8]

# Add rownames to front (for CSV output):
(life.n    <- cbind(rownames(life.n),    life.n))
(life.prop <- cbind(rownames(life.prop), life.prop))

# Add group counts as the top row
# n:
(life.n.gc <- as.data.frame(rbind(
  c("(weighted group-n ->)", round(wc.A, 0), gwc.row),
  life.n)))
# prop:
(life.prop.gc <- as.data.frame(rbind(
  c("(group-n ->)", c.A, gc.row),
  life.prop)))
(life.both <- cbind(life.n.gc, life.prop.gc)) # both

# Output CSV tables:
# write_csv(life.n.gc, "life.n_W.csv")
write_csv(life.prop.gc, "life.prop_W.csv")
# write_csv(life.both, "life.both_W.csv")
```

```
### Plot within-group lifetime percentages for each group:
(xlabels <- life.prop[,1])

# B (and never):
plottable <- rbind(
  cbind(xlabels, life.prop[,"PL.B"], c("Psilocybin\nand/or LSD")),
  cbind(xlabels, life.prop[, "P.B"], c("Psilocybin")),
  cbind(xlabels, life.prop[, "L.B"], c("LSD")),
  cbind(xlabels, life.prop[,   "A"], c("Psychedelics:\nNever used")))
colnames(plottable) <- c("lifetime", "prop", "Psychedelic")
plottable     <- as.tibble(plottable)
plottable[,2] <- as.double(unlist(plottable[,2]))

ggplot(plottable, aes(
  x=factor(lifetime, levels=c("psilo", "lsd", "pcp", "ecst", "ciga", "snuf",
"chew", "pipe", "alco", "mari","coca", "crack", "hero", "inha", "pain",
"tran", "stim", "seda")),
  y=prop, color=Psychedelic, group=Psychedelic)) +
geom_point() + geom_line() + theme_bw() +
theme(legend.direction="vertical", legend.position=c(0.903, 0.8)) +
scale_colour_manual(values=c("orange", "blue", "forestgreen", "black")) +
xlab("Lifetime use (even once)") +
ylab("Proportion of group (weighted %)")
ggsave(width=7, height=4, units="in", "life B (>12)_W.png")

# C (and never):
plottable <- rbind(
  cbind(xlabels, life.prop[,"PL.C"], c("Psilocybin\nand/or LSD")),
  cbind(xlabels, life.prop[, "P.C"], c("Psilocybin")),
  cbind(xlabels, life.prop[, "L.C"], c("LSD")),
  cbind(xlabels, life.prop[,   "A"], c("Psychedelics:\nNever used")))
colnames(plottable) <- c("lifetime", "prop", "Psychedelic")
plottable     <- as.tibble(plottable)
plottable[,2] <- as.double(unlist(plottable[,2]))

ggplot(plottable, aes(
  x=factor(lifetime, levels=c("psilo", "lsd", "pcp", "ecst", "ciga", "snuf",
"chew", "pipe", "alco", "mari","coca", "crack", "hero", "inha", "pain",
"tran", "stim", "seda")),
  y=prop, color=Psychedelic, group=Psychedelic)) +
geom_point() + geom_line() + theme_bw() +
theme(legend.direction="vertical", legend.position=c(0.903, 0.8)) +
scale_colour_manual(values=c("orange", "blue", "forestgreen", "black")) +
xlab("Lifetime use (even once)") +
ylab("Proportion of group (weighted %)")
ggsave(width=7, height=4, units="in", "life C (1-12)_W.png")

# D (and never):
plottable <- rbind(
```

```
  cbind(xlabels, life.prop[,"PL.D"], c("Psilocybin\nand/or LSD")),
  cbind(xlabels, life.prop[, "P.D"], c("Psilocybin")),
  cbind(xlabels, life.prop[, "L.D"], c("LSD")),
  cbind(xlabels, life.prop[,   "A"], c("Psychedelics:\nNever used")))
colnames(plottable) <- c("lifetime", "prop", "Psychedelic")
plottable     <- as.tibble(plottable)
plottable[,2] <- as.double(unlist(plottable[,2]))

ggplot(plottable, aes(
  x=factor(lifetime, levels=c("psilo", "lsd", "pcp", "ecst", "ciga", "snuf",
"chew", "pipe", "alco", "mari","coca", "crack", "hero", "inha", "pain",
"tran", "stim", "seda")),
  y=prop, color=Psychedelic, group=Psychedelic)) +
geom_point() + geom_line() + theme_bw() +
theme(legend.direction="vertical", legend.position=c(0.903, 0.8)) +
  scale_colour_manual(values=c("orange", "blue", "forestgreen", "black")) +
xlab("Lifetime use (even once)") +
ylab("Proportion of group (weighted %)")
ggsave(width=7, height=4, units="in", "life D (<1)_W.png")

# CROSSTAB WITHIN-SUBGROUP PROPORTIONS (%) OF DEMOGRAPHIC VARIABLES
# (CATAG7, EDUCCAT2, irsex, NEWRACE2, irmarit, income, rkfqrsky):
# CATAG7:
age.n <- cbind(svytable(~CATAG7 +PL.gr, desg),
               svytable(~CATAG7 +P.gr, desg)[,-1],
               svytable(~CATAG7 +L.gr, desg)[,-1])
rownames(age.n) <- c("12-13", "14-15", "16-17", "18-20", "21-25", "26-34",
"35+")
age.prop <- round(prop.table(age.n, 2), 3) * 100
# EDUCCAT2:
edu.n <- cbind(svytable(~EDUCCAT2 +PL.gr, desg),
               svytable(~EDUCCAT2 +P.gr, desg )[,-1],
               svytable(~EDUCCAT2 +L.gr, desg )[,-1])
rownames(edu.n) <- c("Less than high school", "High school graduate", "Some
college", "College graduate", "12 to 17 year olds")
edu.prop <- round(prop.table(edu.n, 2), 3) * 100
# irsex:
sex.n <- cbind(svytable(~irsex +PL.gr, desg),
               svytable(~irsex +P.gr, desg )[,-1],
               svytable(~irsex +L.gr, desg )[,-1])
rownames(sex.n) <- c("Male", "Female")
sex.prop <- round(prop.table(sex.n, 2), 3) * 100
# NEWRACE2:
race.n <- cbind(svytable(~NEWRACE2 +PL.gr, desg),
                svytable(~NEWRACE2 +P.gr, desg )[,-1],
                svytable(~NEWRACE2 +L.gr, desg )[,-1])
rownames(race.n) <- c("NonHisp White", "NonHisp Black/Afr Am", "NonHisp
Native Am/AK Native", "NonHisp Native HI/Other Pac Isl", "NonHisp Asian",
"NonHisp more than one race", "Hispanic")
race.prop <- round(prop.table(race.n, 2), 3) * 100
```

```
# irmarit:
mar.n <- cbind(svytable(~irmarit +PL.gr, desg),
               svytable(~irmarit +P.gr, desg )[,-1],
               svytable(~irmarit +L.gr, desg )[,-1])
rownames(mar.n) <- c("Married", "Widowed", "Divorced or Separated", "Never
Been Married", "<= 14 years old")
mar.prop <- round(prop.table(mar.n, 2), 3) * 100
# income:
inc.n <- cbind(svytable(~income +PL.gr, desg),
               svytable(~income +P.gr, desg )[,-1],
               svytable(~income +L.gr, desg )[,-1])
rownames(inc.n) <- c("< 20,000", "20,000-49,999", "50,000-74,999", "75,000")
inc.prop <- round(prop.table(inc.n, 2), 3) * 100
# rkfqrsky:
risk.n <- cbind(svytable(~rkfqrsky +PL.gr, desg),
                svytable(~rkfqrsky +P.gr, desg )[,-1],
                svytable(~rkfqrsky +L.gr, desg )[,-1])
rownames(risk.n) <- c("Never", "Seldom", "Sometimes", "Always")
risk.prop <- round(prop.table(risk.n, 2), 3) * 100

# All (absolute n):
(demo.n <- round(
  rbind(age.n, edu.n, sex.n, race.n, mar.n, inc.n, risk.n),0))
colnames(demo.n) <- c("A", "PL.B", "PL.C", "PL.D", "P.B", "P.C", "P.D",
"L.B", "L.C", "L.D")
# All (proportions):
(demo.prop <- rbind(age.prop, edu.prop, sex.prop, race.prop, mar.prop,
inc.prop, risk.prop))
colnames(demo.prop) <- c("A", "PL.B", "PL.C", "PL.D", "P.B", "P.C", "P.D",
"L.B", "L.C", "L.D")

# Add rownames to front (for CSV output):
(demo.n    <- cbind(rownames(demo.n),    demo.n))
(demo.prop <- cbind(rownames(demo.prop), demo.prop))

# Add group counts as the top row
# n:
(demo.n  <- as.data.frame(rbind(
  c("(weighted group-n ->)", round(wc.A, 0), gwc.row),
  demo.n)))
# prop:
(demo.prop <- as.data.frame(rbind(
  c("(unweighted group-n ->)", c.A, gc.row),
  demo.prop)))
(demo.both <- cbind(demo.n, demo.prop)) # both

# Output CSV tables
# write_csv(demo.n, "demo.n_W.csv")
write_csv(demo.prop, "demo.prop_W.csv")
# write_csv(demo.both, "demo.both_W.csv")
```

```
#### suicthnk.R (run analysis for serious suicidal thoughts)
###### SERIOUS SUICIDAL THOUGHTS (past year)

# Add a variable that indicates the survey design
options(survey.lonely.psu = "adjust")
desg <- svydesign(id=~verep, strata=~vestr, weights=~ANALWC7, data=s.thnk,
nest=TRUE)

#### 1. Minimally adjusted model (adjusting only for sociodemographics & risk
taking)
# PL:
x<-svyglm(suicthnk~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  PL.gr, data=s.thnk, family="binomial", design=desg)
OR.minad.PL <- ORs(x)
# P:
x<-svyglm(suicthnk~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  P.gr, data=s.thnk, family="binomial", design=desg)
OR.minad.P <- ORs(x)
# L:
x<-svyglm(suicthnk~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  L.gr, data=s.thnk, family="binomial", design=desg)
OR.minad.L <- ORs(x)
# All group ORs:
OR.minad.g <- group_ORs(rbind(OR.minad.PL, OR.minad.P, OR.minad.L))

#### 2. Lifetime model (adding adjustments for lifetime non-med. use of other
drugs + past year frequencies of alcohol & marijuana use)
## Time to exclude the observations with unknown lifetime status for these
variables (for this model)
s.life.thnk <- filter(s.thnk,
  cocever!="other", crkever!="other", herever!="other", inhever!="other",
  anlever!="other", trnever!="other", stmever!="other", sedever!="other")
# PL:
x<-svyglm(suicthnk~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq +
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  PL.gr, data=s.life.thnk, family="binomial", design=desg)
OR.life.PL <- ORs(x)
# P:
x<-svyglm(suicthnk~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq +
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  P.gr, data=s.life.thnk, family="binomial", design=desg)
OR.life.P <- ORs(x)
# L:
x<-svyglm(suicthnk~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq +
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  L.gr, data=s.life.thnk, family="binomial", design=desg)
OR.life.L <- ORs(x)
```

```
# All group ORs:
OR.life.g <- group_ORs(rbind(OR.life.PL, OR.life.P, OR.life.L))

#### 3. Recency model (adjusting instead for the recencies of non-med. use of
the same drugs/categories as in model 2)
# PL:
x<-svyglm(suicthnk~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq +
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  PL.gr, data=s.thnk, family="binomial", design=desg)
OR.rec.PL <- ORs(x)
# P:
x<-svyglm(suicthnk~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  P.gr, data=s.thnk, family="binomial", design=desg)
OR.rec.P <- ORs(x)
# L:
x<-svyglm(suicthnk~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  L.gr, data=s.thnk, family="binomial", design=desg)
OR.rec.L <- ORs(x)
# All group ORs:
OR.rec.g <- group_ORs(rbind(OR.rec.PL, OR.rec.P, OR.rec.L))
ORs.thnk <- OR.rec.g

# Combine & plot all ORs from all models (1-3) & groups.
plot_all_ORs(OR.minad.g, OR.life.g, OR.rec.g,
             "aOR (95% CI) for serious suicidal thoughts")
ggsave(width=7, height=4, units="in", "bin_suic_thnk.png")
```

```
#### suicplan.R (run analysis for suicide plans)
#### SUICIDE PLANS (past year)

# Add a variable that indicates the survey design
options(survey.lonely.psu = "adjust")
desg <- svydesign(id=~verep, strata=~vestr, weights=~ANALWC7, data=s.plan,
nest=TRUE)

#### 1. Minimally adjusted model (adjusting only for sociodemographics & risk
taking)
# PL:
x<-svyglm(suicplan~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  PL.gr, data=s.plan, family="binomial", design=desg)
OR.minad.PL <- ORs(x)
# P:
x<-svyglm(suicplan~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  P.gr, data=s.plan, family="binomial", design=desg)
OR.minad.P <- ORs(x)
# L:
x<-svyglm(suicplan~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  L.gr, data=s.plan, family="binomial", design=desg)
OR.minad.L <- ORs(x)
# All group ORs:
OR.minad.g <- group_ORs(rbind(OR.minad.PL, OR.minad.P, OR.minad.L))

#### 2. Lifetime model (adding adjustments for lifetime non-med. use of other
drugs + past year frequencies of alcohol & marijuana use)
## Time to exclude the observations with unknown lifetime status for these
variables (for this model)
s.life.plan <- filter(s.plan,
  cocever!="other", crkever!="other", herever!="other", inhever!="other",
  anlever!="other", trnever!="other", stmever!="other", sedever!="other")
# PL:
x<-svyglm(suicplan~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq +
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  PL.gr, data=s.life.plan, family="binomial", design=desg)
OR.life.PL <- ORs(x)
# P:
x<-svyglm(suicplan~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq +
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  P.gr, data=s.life.plan, family="binomial", design=desg)
OR.life.P <- ORs(x)
# L:
x<-svyglm(suicplan~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq +
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  L.gr, data=s.life.plan, family="binomial", design=desg)
OR.life.L <- ORs(x)
```

```
# All group ORs:
OR.life.g <- group_ORs(rbind(OR.life.PL, OR.life.P, OR.life.L))

#### 3. Recency model (adjusting instead for the recencies of non-med. use of
the same drugs/categories as in model 2)
# PL:
x<-svyglm(suicplan~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq +
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  PL.gr, data=s.plan, family="binomial", design=desg)
OR.rec.PL <- ORs(x)
# P:
x<-svyglm(suicplan~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  P.gr, data=s.plan, family="binomial", design=desg)
OR.rec.P <- ORs(x)
# L:
x<-svyglm(suicplan~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  L.gr, data=s.plan, family="binomial", design=desg)
OR.rec.L <- ORs(x)
# All group ORs:
OR.rec.g <- group_ORs(rbind(OR.rec.PL, OR.rec.P, OR.rec.L))
ORs.plan <- OR.rec.g

# Combine & plot all ORs from all models (1-3) & groups.
plot_all_ORs(OR.minad.g, OR.life.g, OR.rec.g,
             "aOR (95% CI) for suicide plans")
ggsave(width=7, height=4, units="in", "bin_suic_plan.png")
```

```
#### suictry.R (run analysis for suicide attempt)
###### SUICIDE ATTEMPT (past year)

# Add a variable that indicates the survey design
options(survey.lonely.psu = "adjust")
desg <- svydesign(id=~verep, strata=~vestr, weights=~ANALWC7, data=s.try,
nest=TRUE)

#### 1. Minimally adjusted model (adjusting only for sociodemographics & risk
taking)
# PL:
x<-svyglm(suictry ~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  PL.gr, data=s.try, family="binomial", design=desg)
OR.minad.PL <- ORs(x)
# P:
x<-svyglm(suictry ~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  P.gr, data=s.try, family="binomial", design=desg)
OR.minad.P <- ORs(x)
# L:
x<-svyglm(suictry ~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  L.gr, data=s.try, family="binomial", design=desg)
OR.minad.L <- ORs(x)
# All group ORs:
OR.minad.g <- group_ORs(rbind(OR.minad.PL, OR.minad.P, OR.minad.L))

#### 2. Lifetime model (adding adjustments for lifetime non-med. use of other
drugs + past year frequencies of alcohol & marijuana use)
## Time to exclude the observations with unknown lifetime status for these
variables (for this model)
s.life.try <- filter(s.try,
  cocever!="other", crkever!="other", herever!="other", inhever!="other",
  anlever!="other", trnever!="other", stmever!="other", sedever!="other")
# PL:
x<-svyglm(suictry ~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq +
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  PL.gr, data=s.life.try, family="binomial", design=desg)
OR.life.PL <- ORs(x)
# P:
x<-svyglm(suictry ~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq +
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  P.gr, data=s.life.try, family="binomial", design=desg)
OR.life.P <- ORs(x)
# L:
x<-svyglm(suictry ~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq +
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  L.gr, data=s.life.try, family="binomial", design=desg)
OR.life.L <- ORs(x)
```

```
# All group ORs:
OR.life.g <- group_ORs(rbind(OR.life.PL, OR.life.P, OR.life.L))

#### 3. Recency model (adjusting instead for the recencies of non-med. use of
the same drugs/categories as in model 2)
# PL:
x<-svyglm(suictry ~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq +
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  PL.gr, data=s.try, family="binomial", design=desg)
OR.rec.PL <- ORs(x)
# P:
x<-svyglm(suictry ~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  P.gr, data=s.try, family="binomial", design=desg)
OR.rec.P <- ORs(x)
# L:
x<-svyglm(suictry ~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  L.gr, data=s.try, family="binomial", design=desg)
OR.rec.L <- ORs(x)
# All group ORs:
OR.rec.g <- group_ORs(rbind(OR.rec.PL, OR.rec.P, OR.rec.L))
ORs.try <- OR.rec.g

# Combine & plot all ORs from all models (1-3) & groups.
plot_all_ORs(OR.minad.g, OR.life.g, OR.rec.g,
             "aOR (95% CI) for suicide attempt")
ggsave(width=7, height=4, units="in", "bin_suic_attempt.png")
```

```
#### K6_13.R (run analysis for serious psychological distress)
#### Past month SERIOUS PSYCHOLOGICAL DISTRESS (K6 ≥ 13)

# Add a variable that indicates the survey design
options(survey.lonely.psu = "adjust")
desg <- svydesign(id=~verep, strata=~vestr, weights=~ANALWC7, data=s.K6,
nest=TRUE)

#### 1. Minimally adjusted model (adjusting only for sociodemographics & risk
taking)
# PL:
x<-svyglm(K6_Ov12~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  PL.gr, data=s.K6, family="binomial", design=desg)
OR.minad.PL <- ORs(x)
# P:
x<-svyglm(K6_Ov12~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  P.gr, data=s.K6, family="binomial", design=desg)
OR.minad.P <- ORs(x)
# L:
x<-svyglm(K6_Ov12~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  L.gr, data=s.K6, family="binomial", design=desg)
OR.minad.L <- ORs(x)
# All group ORs:
OR.minad.g <- group_ORs(rbind(OR.minad.PL, OR.minad.P, OR.minad.L))

#### 2. Lifetime model (adding adjustments for lifetime non-med. use of other
drugs + past year frequencies of alcohol & marijuana use)
## Time to exclude the observations with unknown lifetime status for these
variables (for this model)
s.life.K6 <- filter(s.K6,
  cocever!="other", crkever!="other", herever!="other", inhever!="other",
  anlever!="other", trnever!="other", stmever!="other", sedever!="other")
# PL:
x<-svyglm(K6_Ov12~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  PL.gr, data=s.life.K6, family="binomial", design=desg)
OR.life.PL <- ORs(x)
# P:
x<-svyglm(K6_Ov12~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  P.gr, data=s.life.K6, family="binomial", design=desg)
OR.life.P <- ORs(x)
# L:
x<-svyglm(K6_Ov12~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  L.gr, data=s.life.K6, family="binomial", design=desg)
OR.life.L <- ORs(x)
```

```
# All group ORs:
OR.life.g <- group_ORs(rbind(OR.life.PL, OR.life.P, OR.life.L))

#### 3. Recency model (adjusting instead for the recencies of non-med. use of
the same drugs/categories as in model 2)
# PL:
x<-svyglm(K6_Ov12~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  PL.gr, data=s.K6, family="binomial", design=desg)
OR.rec.PL <- ORs(x)
# P:
x<-svyglm(K6_Ov12~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  P.gr, data=s.K6, family="binomial", design=desg)
OR.rec.P <- ORs(x)
# L:
x<-svyglm(K6_Ov12~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  L.gr, data=s.K6, family="binomial", design=desg)
OR.rec.L <- ORs(x)
# All group ORs:
OR.rec.g <- group_ORs(rbind(OR.rec.PL, OR.rec.P, OR.rec.L))
ORs.K6.13 <- OR.rec.g

# Combine & plot all ORs from all models (1-3) & groups.
plot_all_ORs(OR.minad.g, OR.life.g, OR.rec.g,
             "aOR (95% CI) for serious psychological distress")
ggsave(width=7, height=4, units="in", "bin_K6_13.png")
```

```
#### K6_5.R (run analysis for moderate psychological distress)
#### Past month MODERATE PSYCHOLOGICAL DISTRESS (K6 ≥ 5)

# Add a variable that indicates the survey design
options(survey.lonely.psu = "adjust")
desg <- svydesign(id=~verep, strata=~vestr, weights=~ANALWC7, data=s.K6,
nest=TRUE)

#### 1. Minimally adjusted model (adjusting only for sociodemographics & risk
taking)
# PL:
x<-svyglm(K6_Ov4~ irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  PL.gr, data=s.K6, family="binomial", design=desg)
OR.minad.PL <- ORs(x)
# P:
x<-svyglm(K6_Ov4~ irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  P.gr, data=s.K6, family="binomial", design=desg)
OR.minad.P <- ORs(x)
# L:
x<-svyglm(K6_Ov4~ irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  L.gr, data=s.K6, family="binomial", design=desg)
OR.minad.L <- ORs(x)
# All group ORs:
OR.minad.g <- group_ORs(rbind(OR.minad.PL, OR.minad.P, OR.minad.L))

#### 2. Lifetime model (adding adjustments for lifetime non-med. use of other
drugs + past year frequencies of alcohol & marijuana use)
## Time to exclude the observations with unknown lifetime status for these
variables (for this model)
s.life.K6 <- filter(s.K6,
  cocever!="other", crkever!="other", herever!="other", inhever!="other",
  anlever!="other", trnever!="other", stmever!="other", sedever!="other")
# PL:
x<-svyglm(K6_Ov4~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  PL.gr, data=s.life.K6, family="binomial", design=desg)
OR.life.PL <- ORs(x)
# P:
x<-svyglm(K6_Ov4~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  P.gr, data=s.life.K6, family="binomial", design=desg)
OR.life.P <- ORs(x)
# L:
x<-svyglm(K6_Ov4~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  L.gr, data=s.life.K6, family="binomial", design=desg)
OR.life.L <- ORs(x)
```

```
# All group ORs:
OR.life.g <- group_ORs(rbind(OR.life.PL, OR.life.P, OR.life.L))

#### 3. Recency model (adjusting instead for the recencies of non-med. use of
the same drugs/categories as in model 2)
# PL:
x<-svyglm(K6_Ov4~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  PL.gr, data=s.K6, family="binomial", design=desg)
OR.rec.PL <- ORs(x)
# P:
x<-svyglm(K6_Ov4~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  P.gr, data=s.K6, family="binomial", design=desg)
OR.rec.P <- ORs(x)
# L:
x<-svyglm(K6_Ov4~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  L.gr, data=s.K6, family="binomial", design=desg)
OR.rec.L <- ORs(x)
# All group ORs:
OR.rec.g <- group_ORs(rbind(OR.rec.PL, OR.rec.P, OR.rec.L))
ORs.K6.5 <- OR.rec.g

# Combine & plot all ORs from all models (1-3) & groups.
plot_all_ORs(OR.minad.g, OR.life.g, OR.rec.g,
             "aOR (95% CI) for moderate psychological distress")
ggsave(width=7, height=4, units="in", "bin_K6_5.png")
```

```
#### WHODAS.R (run analysis for everyday impairment)
#### WHODAS (EVERYDAY IMPAIRMENT during worst month of past year)

# Add a variable that indicates the survey design
options(survey.lonely.psu = "adjust")
desg <- svydesign(id=~verep, strata=~vestr, weights=~ANALWC7, data=s.WHODAS,
nest=TRUE)

#### 1. Minimally adjusted model (adjusting only for sociodemographics & risk
taking)
# PL:
x<-svyglm(WHODAS_Ov3~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  PL.gr, data=s.WHODAS, family="binomial", design=desg)
OR.minad.PL <- ORs(x)
# P:
x<-svyglm(WHODAS_Ov3~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  P.gr, data=s.WHODAS, family="binomial", design=desg)
OR.minad.P <- ORs(x)
# L:
x<-svyglm(WHODAS_Ov3~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  L.gr, data=s.WHODAS, family="binomial", design=desg)
OR.minad.L <- ORs(x)
# All group ORs:
OR.minad.g <- group_ORs(rbind(OR.minad.PL, OR.minad.P, OR.minad.L))

#### 2. Lifetime model (adding adjustments for lifetime non-med. use of other
drugs + past year frequencies of alcohol & marijuana use)
## Time to exclude the observations with unknown lifetime status for these
variables (for this model)
s.life.WHODAS <- filter(s.WHODAS,
  cocever!="other", crkever!="other", herever!="other", inhever!="other",
  anlever!="other", trnever!="other", stmever!="other", sedever!="other")
# PL:
x<-svyglm(WHODAS_Ov3~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  PL.gr, data=s.life.WHODAS, family="binomial", design=desg)
OR.life.PL <- ORs(x)
# P:
x<-svyglm(WHODAS_Ov3~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  P.gr, data=s.life.WHODAS, family="binomial", design=desg)
OR.life.P <- ORs(x)
# L:
x<-svyglm(WHODAS_Ov3~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
```

```
  cocever+crkever+herever+inhever+anlever+trnever+stmever+sedever+ecstasy+
  L.gr, data=s.life.WHODAS, family="binomial", design=desg)
OR.life.L <- ORs(x)
# All group ORs:
OR.life.g <- group_ORs(rbind(OR.life.PL, OR.life.P, OR.life.L))

#### 3. Recency model (adjusting instead for the recencies of non-med. use of
the same drugs/categories as in model 2)
# PL:
x<-svyglm(WHODAS_Ov3~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  PL.gr, data=s.WHODAS, family="binomial", design=desg)
OR.rec.PL <- ORs(x)
# P:
x<-svyglm(WHODAS_Ov3~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  P.gr, data=s.WHODAS, family="binomial", design=desg)
OR.rec.P <- ORs(x)
# L:
x<-svyglm(WHODAS_Ov3~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  ircocrc+ircrkrc+irherrc+irinhrc+iranlrc+irtrnrc+irstmrc+irsedrc+ecsrec+
  L.gr, data=s.WHODAS, family="binomial", design=desg)
OR.rec.L <- ORs(x)
# All group ORs:
OR.rec.g <- group_ORs(rbind(OR.rec.PL, OR.rec.P, OR.rec.L))
ORs.WHODAS <- OR.rec.g

# Combine & plot all ORs from all models (1-3) & groups.
plot_all_ORs(OR.minad.g, OR.life.g, OR.rec.g,
             "aOR (95% CI) for serious everyday impairment")
ggsave(width=7, height=4, units="in", "bin_WHODAS.png")
```

```
#### outcomes.R (compute & output a table of combined aORs & 95% CIs)
# Add ORs (95% CIs) for each subgroup*outcome
(ORs.thnk <- round(ORs.thnk, 2))
(ORs.plan <- round(ORs.plan, 2))
(ORs.try <- round(ORs.try, 2))
(ORs.WHODAS <- round(ORs.WHODAS, 2))
(ORs.K6.13 <- round(ORs.K6.13, 2))
(ORs.K6.5 <- round(ORs.K6.5, 2))
colnames(ORs.thnk)   <- c( "T-aOR",  "T-low",  "T-up")
colnames(ORs.plan)   <- c( "P-aOR",  "P-low",  "P-up")
colnames(ORs.try)    <- c( "A-aOR",  "A-low",  "A-up")
colnames(ORs.WHODAS) <- c( "W-aOR",  "W-low",  "W-up")
colnames(ORs.K6.13)  <- c("13-aOR", "13-low", "13-up")
colnames(ORs.K6.5)   <- c( "5-aOR",  "5-low",  "5-up")
(ORs.all <- cbind(
  ORs.thnk, ORs.plan, ORs.try, ORs.WHODAS, ORs.K6.13, ORs.K6.5))
ORs.all <- as.data.frame(ORs.all)

### Outcome proportions within each subgroup (before accounting for
adjustments)
# PL:
outcomes.PL <- cbind(
  table(s.thnk$PL.gr, s.thnk$suicthnk),
  table(s.plan$PL.gr, s.plan$suicplan),
  table(s.try$PL.gr, s.try$suictry),
  table(s.WHODAS$PL.gr, s.WHODAS$WHODAS_Ov3),
  table(s.K6$PL.gr, s.K6$K6_Ov12),
  table(s.K6$PL.gr, s.K6$K6_Ov4)
)
outcomes.PL[1,] <- outcomes.PL[1,]/c.A*100
outcomes.PL[2,] <- outcomes.PL[2,]/c.PL.B*100
outcomes.PL[3,] <- outcomes.PL[3,]/c.PL.C*100
outcomes.PL[4,] <- outcomes.PL[4,]/c.PL.D*100
colnames(outcomes.PL) <- c("thnk=0", "thnk=1", "plan=0", "plan=1", "try=0",
"try=1", "WH<3", "WH≥3", "K6<13", "K6≥13", "K6<5", "K6≥5")
rownames(outcomes.PL) <- c("PL.A", "PL.B", "PL.C", "PL.D")
# P:
outcomes.P <- cbind(
  table(s.thnk$P.gr, s.thnk$suicthnk),
  table(s.plan$P.gr, s.plan$suicplan),
  table(s.try$P.gr, s.try$suictry),
  table(s.WHODAS$P.gr, s.WHODAS$WHODAS_Ov3),
  table(s.K6$P.gr, s.K6$K6_Ov12),
  table(s.K6$P.gr, s.K6$K6_Ov4)
)
outcomes.P[1,] <- outcomes.P[1,]/c.A*100
outcomes.P[2,] <- outcomes.P[2,]/c.P.B*100
outcomes.P[3,] <- outcomes.P[3,]/c.P.C*100
outcomes.P[4,] <- outcomes.P[4,]/c.P.D*100
rownames(outcomes.P) <- c("P.A", "P.B", "P.C", "P.D")
```

```
# L:
outcomes.L <- cbind(
  table(s.thnk$L.gr, s.thnk$suicthnk),
  table(s.plan$L.gr, s.plan$suicplan),
  table(s.try$L.gr, s.try$suictry),
  table(s.WHODAS$L.gr, s.WHODAS$WHODAS_Ov3),
  table(s.K6$L.gr, s.K6$K6_Ov12),
  table(s.K6$L.gr, s.K6$K6_Ov4)
)
outcomes.L[1,] <- outcomes.L[1,]/c.A*100
outcomes.L[2,] <- outcomes.L[2,]/c.L.B*100
outcomes.L[3,] <- outcomes.L[3,]/c.L.C*100
outcomes.L[4,] <- outcomes.L[4,]/c.L.D*100
rownames(outcomes.L) <- c("L.A", "L.B", "L.C", "L.D")
# All:
(outcomes <- rbind(outcomes.PL, outcomes.P, outcomes.L)[-5,]) # remove
redundant row P.A
(outcomes <- outcomes[-8,]) # remove redundant row L.A
(outcomes <- round(outcomes, 2)) # round
# add rownames (i.e., subgroups) as a factor
(outcomes <- as.tibble(cbind(rownames(outcomes), as.tibble(outcomes))))
(outcomes <- cbind(c(c.A, gc.row), outcomes)) # add subgroup counts

# fix column names now
colnames(outcomes) <- c("uwt n", "group", "thnk=0", "thnk=1", "plan=0",
"plan=1", "try=0", "try=1", "WH<3", "WH≥3", "K6<13", "K6≥13", "K6<5", "K6≥5")

# combine outcome proportions with ORs (& CIs) by subgroup
outcomes <- cbind(outcomes, rbind(c("ref"), ORs.all))

# output combined table
write_csv(as.data.frame(outcomes),"outcomes.psychedelics.csv")
```

```
#### OAB.R (run analysis for overadjustment bias)
# Interpret recencies as continuous (Never becomes 1; >12 becomes 2; 1-12
becomes 3; and <1 becomes 4) to compute correlations between psychedelic
recency groups & other recencies (in order to examine possible overadjustment
bias):
soab <- mutate(s.K6,
ircocrc.c=case_when(ircocrc==9~1,ircocrc==3~2,ircocrc==2~3,ircocrc==1~4),
ircrkrc.c=case_when(ircrkrc==9~1,ircrkrc==3~2,ircrkrc==2~3,ircrkrc==1~4),
irherrc.c=case_when(irherrc==9~1,irherrc==3~2,irherrc==2~3,irherrc==1~4),
irinhrc.c=case_when(irinhrc==9~1,irinhrc==3~2,irinhrc==2~3,irinhrc==1~4),
iranlrc.c=case_when(iranlrc==9~1,iranlrc==3~2,iranlrc==2~3,iranlrc==1~4),
irtrnrc.c=case_when(irtrnrc==9~1,irtrnrc==3~2,irtrnrc==2~3,irtrnrc==1~4),
irstmrc.c=case_when(irstmrc==9~1,irstmrc==3~2,irstmrc==2~3,irstmrc==1~4),
irsedrc.c=case_when(irsedrc==9~1,irsedrc==3~2,irsedrc==2~3,irsedrc==1~4),
  PL.gr.c=case_when(PL.gr=="A"~1,PL.gr=="B"~2,PL.gr=="C"~3,PL.gr=="D"~4),
   P.gr.c=case_when( P.gr=="A"~1, P.gr=="B"~2, P.gr=="C"~3, P.gr=="D"~4),
   L.gr.c=case_when( L.gr=="A"~1, L.gr=="B"~2, L.gr=="C"~3, L.gr=="D"~4))
# Tell the correlation to ignore NAs with use argument:
(rc.corrs <- round(cbind(
  rbind(cor(soab$PL.gr.c, soab$ircocrc.c, use="complete.obs"),
        cor(soab$PL.gr.c, soab$ircrkrc.c, use="complete.obs"),
        cor(soab$PL.gr.c, soab$irherrc.c, use="complete.obs"),
        cor(soab$PL.gr.c, soab$irinhrc.c, use="complete.obs"),
        cor(soab$PL.gr.c, soab$iranlrc.c, use="complete.obs"),
        cor(soab$PL.gr.c, soab$irtrnrc.c, use="complete.obs"),
        cor(soab$PL.gr.c, soab$irstmrc.c, use="complete.obs"),
        cor(soab$PL.gr.c, soab$irsedrc.c, use="complete.obs")),
  rbind(cor( soab$P.gr.c, soab$ircocrc.c, use="complete.obs"),
        cor( soab$P.gr.c, soab$ircrkrc.c, use="complete.obs"),
        cor( soab$P.gr.c, soab$irherrc.c, use="complete.obs"),
        cor( soab$P.gr.c, soab$irinhrc.c, use="complete.obs"),
        cor( soab$P.gr.c, soab$iranlrc.c, use="complete.obs"),
        cor( soab$P.gr.c, soab$irtrnrc.c, use="complete.obs"),
        cor( soab$P.gr.c, soab$irstmrc.c, use="complete.obs"),
        cor( soab$P.gr.c, soab$irsedrc.c, use="complete.obs")),
  rbind(cor( soab$L.gr.c, soab$ircocrc.c, use="complete.obs"),
        cor( soab$L.gr.c, soab$ircrkrc.c, use="complete.obs"),
        cor( soab$L.gr.c, soab$irherrc.c, use="complete.obs"),
        cor( soab$L.gr.c, soab$irinhrc.c, use="complete.obs"),
        cor( soab$L.gr.c, soab$iranlrc.c, use="complete.obs"),
        cor( soab$L.gr.c, soab$irtrnrc.c, use="complete.obs"),
        cor( soab$L.gr.c, soab$irstmrc.c, use="complete.obs"),
        cor( soab$L.gr.c, soab$irsedrc.c, use="complete.obs"))
), 3)
)

# name cols & rows
colnames(rc.corrs)<-c("PL", "P", "L")
rownames(rc.corrs)<-c("coc", "crk", "her", "inh", "anl", "trn", "stm", "sed")
# sort by first column (PL) in decreasing order
```

```
(rc.corrs <- rc.corrs[order(rc.corrs[,1], decreasing = TRUE), ])

## Examine correlations:
# Their (crack & heroin recency) mutual correlation is only 0.39 so we might
include them as controls in each other's models.
cor(soab$ircrkrc.c, soab$irherrc.c) # 0.39
cor(soab$ircocrc.c, soab$ircrkrc.c) # cocaine & crack cocaine, 0.475

# Factorize predictors (crack cocaine & heroin recency)
soab$ircrkrc.c <- as.factor(soab$ircrkrc.c)
soab$irherrc.c <- as.factor(soab$irherrc.c)
soab$PL.gr <- as.factor(soab$PL.gr) # also factorize PL.gr as a control var

###### Examine overadjustment bias:
###### See whether crack cocaine / heroin recency begins to be associated
with a lower likelihood for past month serious nonspecific psychological
distress (K6 ≥ 13) when adjustments improve from Minimal to Lifetimes and
Recencies. (Such an outcome might give reason to doubt the relationship
between psychedelic recency and K6 ≥ 13 as well.)

##### Serious (K6 ≥ 13) ~ CRACK COCAINE

#### 1. Minimally adjusted model (adjusting only for sociodemographics & risk
taking)
options(survey.lonely.psu = "adjust")
desg <- svydesign(id=~verep, strata=~vestr, weights=~ANALWC7, data=soab,
nest=TRUE)
x<-svyglm(K6_Ov12~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  ircrkrc.c, data=soab, family="binomial", design=desg)
OR.minad <- ORs(x)
OR.K6.1 <- cbind(
  c("minad", "minad", "minad"),
  c("Crack >12", "Crack 1-12", "Crack <1"),
  round(as.data.frame(rbind(OR.minad["ircrkrc.c2",],
                            OR.minad["ircrkrc.c3",],
                            OR.minad["ircrkrc.c4",])),2)
)
colnames(OR.K6.1) <- c("Adjustments", "Group", "aOR", "low", "up")

#### 2. Lifetime model (adding adjustments for lifetime non-med. use of other
drugs + past year frequencies of alcohol & marijuana use)
## Time to exclude the observations with unknown lifetime status for these
variables (for this model)
soab.life <- filter(soab,
  cocever!="other", herever!="other", inhever!="other", crkever!="other",
  anlever!="other", trnever!="other", stmever!="other", sedever!="other",
  psilcy !="other",   "lsd"!="other")
options(survey.lonely.psu = "adjust")
desg <- svydesign(id=~verep, strata=~vestr, weights=~ANALWC7, data=soab.life,
nest=TRUE)
```

```
x<-svyglm(K6_Ov12~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
cocever+inhever+stmever+trnever+anlever+herever+sedever+psilcy+lsd+ecstasy+
ircrkrc.c, data=soab.life, family="binomial", design=desg)
OR.life <- ORs(x)
OR.K6.2 <- cbind(
  c("Lifetimes", "Lifetimes", "Lifetimes"),
  c("Crack >12", "Crack 1-12", "Crack <1"),
  round(as.data.frame(rbind(OR.life["ircrkrc.c2",],
                            OR.life["ircrkrc.c3",],
                            OR.life["ircrkrc.c4",])),2)
)
colnames(OR.K6.2) <- c("Adjustments", "Group", "aOR", "low", "up")

#### 3. Recency model (adjusting instead for the recencies of non-med. use of
the same drugs/categories as in model 2)
options(survey.lonely.psu = "adjust")
desg <- svydesign(id=~verep, strata=~vestr, weights=~ANALWC7, data=soab,
nest=TRUE)
x<-svyglm(K6_Ov12~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  ircocrc+irinhrc+irstmrc+irtrnrc+iranlrc+irherrc+irsedrc+PL.gr+ecsrec+
  ircrkrc.c, data=soab, family="binomial", design=desg)
OR.rec <- ORs(x)
OR.K6.3 <- cbind(
  c("Recencies", "Recencies", "Recencies"),
  c("Crack >12", "Crack 1-12", "Crack <1"),
  round(as.data.frame(rbind(OR.rec["ircrkrc.c2",],
                            OR.rec["ircrkrc.c3",],
                            OR.rec["ircrkrc.c4",])),2)
)
colnames(OR.K6.3) <- c("Adjustments", "Group", "aOR", "low", "up")
### Combine all ORs (95% CIs) across the models (minad, Lifetimes, Recencies)
(OR.K6.13.crk <- rbind(OR.K6.1, OR.K6.2, OR.K6.3))

##### Serious (K6 ≥ 13) ~ HEROIN

#### 1. Minimally adjusted model (adjusting only for sociodemographics & risk
taking)
options(survey.lonely.psu = "adjust")
desg <- svydesign(id=~verep, strata=~vestr, weights=~ANALWC7, data=soab,
nest=TRUE)
x<-svyglm(K6_Ov12~irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+
  irherrc.c, data=soab, family="binomial", design=desg)
OR.minad <- ORs(x)
OR.K6.1 <- cbind(
  c("minad", "minad", "minad"),
  c("Heroin >12", "Heroin 1-12", "Heroin <1"),
  round(as.data.frame(rbind(OR.minad["irherrc.c2",],
                            OR.minad["irherrc.c3",],
```

```
                          OR.minad["irherrc.c4",])),2)
)
colnames(OR.K6.1) <- c("Adjustments", "Group", "aOR", "low", "up")

#### 2. Lifetime model (adding adjustments for lifetime non-med. use of other
drugs + past year frequencies of alcohol & marijuana use)
## Time to exclude the observations with unknown lifetime status for these
variables (for this model)
soab.life <- filter(soab,
  cocever!="other", herever!="other", inhever!="other", crkever!="other",
  anlever!="other", trnever!="other", stmever!="other", sedever!="other",
  psilcy !="other",   "lsd"!="other")
options(survey.lonely.psu = "adjust")
desg <- svydesign(id=~verep, strata=~vestr, weights=~ANALWC7, data=soab.life,
nest=TRUE)
x<-svyglm(K6_Ov12~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
cocever+inhever+stmever+trnever+anlever+crkever+sedever+psilcy+lsd+ecstasy+
irherrc.c, data=soab.life, family="binomial", design=desg)
OR.life <- ORs(x)
OR.K6.2 <- cbind(
  c("Lifetimes", "Lifetimes", "Lifetimes"),
  c("Heroin >12", "Heroin 1-12", "Heroin <1"),
  round(as.data.frame(rbind(OR.life["irherrc.c2",],
                          OR.life["irherrc.c3",],
                          OR.life["irherrc.c4",])),2)
)
colnames(OR.K6.2) <- c("Adjustments", "Group", "aOR", "low", "up")

#### 3. Recency model (adjusting instead for the recencies of non-med. use of
the same drugs/categories as in model 2)
options(survey.lonely.psu = "adjust")
desg <- svydesign(id=~verep, strata=~vestr, weights=~ANALWC7, data=soab,
nest=TRUE)
x<-svyglm(K6_Ov12~
  irsex+NEWRACE2+CATAG7+EDUCCAT2+irmarit+income+rkfqrsky+alcfreq+mrjfreq+
  ircocrc+irinhrc+irstmrc+irtrnrc+iranlrc+ircrkrc+irsedrc+PL.gr+ecsrec+
  irherrc.c, data=soab, family="binomial", design=desg)
OR.rec <- ORs(x)
OR.rec
OR.K6.3 <- cbind(
  c("Recencies", "Recencies", "Recencies"),
  c("Heroin >12", "Heroin 1-12", "Heroin <1"),
  round(as.data.frame(rbind(OR.rec["irherrc.c2",],
                          OR.rec["irherrc.c3",],
                          OR.rec["irherrc.c4",])),2)
)
colnames(OR.K6.3) <- c("Adjustments", "Group", "aOR", "low", "up")
### Combine all ORs (95% CIs) across the models (minad, Lifetimes, Recencies)
(OR.K6.13.her <- rbind(OR.K6.1, OR.K6.2, OR.K6.3))
```

```
oab.both <- rbind(OR.K6.13.crk, OR.K6.13.her)
colnames(oab.both) <- c("Adjustments", "Group", "13-aOR", "13-low", "13-up")
oab.both
write_csv(oab.both, "outcomes.OAB.both.csv")
```